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## **PREDICTION OF PERFORMANCE OF THE PHARMACEUTICAL COMPANIES ACCEPTED BY TEHRAN STOCK EXCHANGE BY USING ARTIFICIAL NEURAL NETWORKS**

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### **ABSTRACT**

This research aims to predict and present a strategy for finding economic value added as a representative of the company's performance factor of the pharmaceutical companies accepted by Tehran Stock Exchange. The predictions of this research are based on the information extracted from audited financial statements. The research data are the data related to the years 2009 to 2013. After necessary calculations, we will proceed to prediction of economic value added by using regression. We also perform the same prediction by artificial neural networks and compare the predictions with the reality. In conclusion, this research indicates that the predictions performed by artificial neural networks have better performance in ratio to linear regression.

**Keywords:** *Neural Network, Economic Value Added, Financial Ratios*

### **INTRODUCTION**

With the advent of large corporations and the formation of the separation of ownership from management and creating a huge conflict of interest between owners and managers, the evaluation of the performance of companies and their leaders is the subjects of various classes of creditors, owners of the government and even managers. Furthermore, the separation of ownership from management of which is the most important goals of the company creates value and increases the shareholder wealth. And increasing wealth will be achieved through desired Function. So users look for an index to determine the achievement to the most important target of the company. In the vision of shareholders increasing the wealth through increasing the price and company value or through the dividend is important. But what is more important is the perspective of investors. Because these people are not willing to invest in companies with high risk and even if they do beside higher risk, higher yields would be expected. So they look for an indicator for assessing the performance of companies to make an investment decision.

#### **Statement of Problem**

With the advent of large corporations and the formation of the separation of ownership from management and creating a huge conflict of interest between owners and managers, the evaluation of the performance of companies and their leaders is the subjects of various classes of creditors, owners of the government and even managers. Furthermore, the separation of ownership from management of which is the most important goals of the company creates value and increases the shareholder wealth. And increasing wealth will be achieved through desired Function. So users look for an index to determine the achievement to the most important target of the company. In the past, one of the criteria used in this context, is the rate of return on assets and return on equity of share owners or DuPont system that was used from 1980 onwards. Another method used in the 1990s is called EVA. The first was raised by a management consulting group called Stern Stewart Co. This method focuses on the creation or destruction of capital in summary (the Company). In other words, this method shows the returns after the deduction of the costs of financing through debt and owner's equity. According to the studies and results, as well as drawbacks against a net profit such as smoothing, the effect of estimations, different tastes and ignoring the cost of financing through equity (investment opportunity costs) in profit calculation and etc. .. benchmark rate of return on assets is questionable. Since the objections were removed from the economic added value measure and also in EVA calculation total cost of financial resources of companies, including the (the cost of is the opportunity to invest) are considered so the Economic Added

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Value measure would be more appropriated for evaluating the performance of the company. Using of methods or techniques to achieve the future state has always been the main concern of scientists in different fields. In this context, naturally the methods have proper retention and use that are capable of forecasting with the lowest error. On the basis mathematical methods in many years, both the average (simple, synonyms, double) and regression and so were the only model that was decisively used and demonstrated - but at different times has had problems (when cannot create relationship between the data and dependent and independent variables by creating artificial intelligence techniques such as neural networks, particularly in cases where the proper mathematical relationship cannot be formed between the dependent and independent data so much hopes came and continued until when they were known as the mathematical methods substitutes.

The basic research question of the paper is whether can predict the economic added value and financial assets of the drug companies in future by using current data?

### **Theoretical Basis**

Residual income valuation models have been subject to many researchers which are handled to such a wide range of investment management. Residual income is equal to the net profit of the company, minus the opportunity cost of capital used to produce profit. Because the cost of equity is not included in the income statement may be the special company profit would be positive number but high profit is not enough to cover the opportunity cost of equity. In this case, in fact, the shareholders of the investment in company, suffered. Residual income with considering the cost of equity solved the problem. One of the financial management authors and researchers in 1964 stated (provided little information about how very important but financial non-recurring decisions are made to financial practitioners). The managers have little information on assets value. On which process and investment projects accepted by a profit unit and rejected by other units?

Thus managers as users require accounting and additional information. On the other hand each business unit to continue decisions operations to adopt appropriate procedures requires evaluating operation and verifying the weaknesses and shortcomings of past actions. In this context, the strategic management requires proper planning and optimization.

### **Literature Review**

Stewart (1991) believes that the profit, earnings per share and earnings growth, are misleading measure of corporate performance and economic added value is the best measure of performance evaluation. After this claim so many studies have been conducted to evaluate this issue. In the studies the relationship between economic added value with market added value and its relationship with the traditional criteria for performance evaluation were compared. Omran *et al.*, (2004) in his study entitled linear and nonlinear relationships between returns and financial ratios evaluated the linear and non-linear relationship between financial ratios and return on equity using correlation analysis and multiple regression. Linear model results showed that the proportion of equity returns ratio is the only ratio that can be used to predict stock returns. Also the nonlinear model results show that the return on assets and return on equity ratios are the better than other ratios to predict stock returns. In general nonlinear models are better than linear models to describe the behavior. Karyl (2005) in the study entitled “comparison of linear and nonlinear models of stock returns” compared and evaluated linear models to predict stock returns and nonlinear return prediction models. To summarize, the outcome has been the results indicate that there is a significant difference between linear and nonlinear models and the number of their variables. In general, nonlinear models are better than linear models. Pagach and Maniac (2007) studied the effects of the firm’s risk management principles on long-term performance. They concluded that the management has no significant effect on the company's performance and stock price. In this context, the efficiency of risk management in companies is questionable. Buse and colleagues (2010) to determine the relationship between corporate governance and performance as well as risk management and corporate governance, examined 1448 companies between 1991 and 2008. Research results have shown that there is not any significant relationship between corporate governance and firm performance, but there is a significant positive relationship between corporate governance and risk management of company.

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**Method of Calculating the Study Main Variables**

**Eva (Economy Added Value)**

For calculating EVA the following formula is used:

$$EVA = (r - c) \times \text{Capital} \quad (1)$$

To calculate the EVA in the above formula of financial approach was used. The kind of selective approach in the calculation of r and Adjustments necessary to convert earnings to NOPAT and the equity of share owners or assets influence the Capital.

Total Return rate on capital

The rate is calculated using the following formula based on funding approach:

$$r = \frac{\text{NOPAT}}{\text{Capital}} \quad (2)$$

Here is the NOPAT is equal to:

Accounting profit after tax

+ Costs of profit

- Tax savings in interest costs

+ Cost of depreciation of investments

+ Cost reduction in the value of inventories

+ Deferred Costs

+ Cost of doubtful receivables

+ Cost of end of service benefits

Effective tax rate \* Interest expense = tax savings of tax saving

Capital investment

Equity of share owners

+ Interest-bearing debt

+ Cost of depreciation of investments

+ Cost of reduction in the value of inventories

+ Deferred Costs

+ Cost of doubtful receivables

+ Cost of end of service benefits

Payment bonds + Prior receiving of the sale + facilities received from banks = debt of Interest-bearing

- capital cost rate

For calculating the rate of cost of capital (WACC) resources weighted average cost of capital method was used. Using this method requires identifying financial resources of companies and then calculation of each of these resources cost rate. Under the balance sheet of test companies, these companies have used the following sources:

1. Interest-bearing debts

2. The new ordinary shares

3. Other components of equity

In this case, the capital cost rate is calculated by average formula as follows:

$$WACC = [W_d \times K_d(1 - t)] + (W_e \times K_e) + (W_s \times K_s) \quad (3)$$

Weight (percent) of each of the resources from total resources =  $W_i$

Capital cost rate of each resource =  $K_i$

Effective tax rate =  $t$

Calculation and measurement of each component of WACC is as follows :

The weight of each resource or  $W_i$

The weight of each resource or  $W_i$  is obtained by dividing the value of each resource by the sum of obtained sources. means:

Other components of share owners' equity and retained earning + new ordinary capital + debts of interest-bearing = sum of resources

$W_d = \text{debts of interest-bearing} / \text{sum of resources}$

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Value of new ordinary capital market/ sum of resources= $W_e$

$W_s$ =equity of share owners and retained earnings/ sum of resources

The cost of each resource or  $K_i$  rate

Rate of debt costs or  $K_d$

Debt cost rate is calculated by the following formula:

$K_d$ =all financial costs/total interest-bearing debts

Cost rate of new ordinary shares

To calculate the rate of supply discounted cash flow (DCF) or Gordon model assuming constant  $g$  are used. The formula is as follows:

$$K_e = \frac{D}{(P - a)} + g \tag{4}$$

Cash dividends per share = $D$

Value of each share= $P$

Costs of equity= $a$

Share profit Growth rate= $g$

Rate of equity cost and retained earnings

To calculate the rate of supply discounted cash flow (DCF) or Gordon model assuming constant  $g$  are used. The formula is as follows :

$$K_e = \frac{D}{(P - a)} + g \tag{5}$$

Cash dividends per share = $D$

Value of each share= $P$

Costs of equity= $a$

dividend growth rate= $g$

How to calculate (dividend growth rate)  $g$

If Gordon model used to calculate the cost of equity or retained earnings, growth rates can be determined by one of the following methods:

- If the growth rate of profits and dividends in the past, were relatively stable and investors anticipate that this trend will continue in the future, in the case  $g$  would be determined on the former growth rate.
- Generally, exchange experts anticipate the corporate earnings and dividend growth and this act is done according to factors such as sales trends, predicted profit margins and other valuable factors.
- At first forecast the average ratio of dividend payments and its supplements or profit maintain ratio and then gain  $g$  through product of the maintenance rate of mean ROE of predicted shareholders' equity return projected to the future.

Profit payment ratio=divided Cash dividends/current year net profit

Maintenance ratio=1-profit payment ratio

$G$ =ROE\*maintenance ratio

Using of financial mathematics model, in this model the future value formula is used to obtain  $g$  . The future value formula to obtain the coming years value of dividends is as follows :

$$FV = PV \times (1 + g)^{n-1} \rightarrow g = \left( \frac{FV}{PV} \right)^{\frac{1}{n-1}} \tag{6}$$

Where:

Typical first year cash profit= $PV$

The number of years in the sample= $n$

Cash profit of the last sample year= $FV$

In this research the  $g$  is calculated using different methods and expertise opinion of the researcher is applied. In most cases false growth rates are obtained.

**Financial Ratios**

Calculation methods of financial ratios are summarized in the following table .

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**Table 1: The formulation of financial ratios**

Financial ratio	Calculation method
<b>Current ratio</b>	<b>Current property</b>
	<b>Current debt</b>
<b>Future ratio</b>	Current Assets - Inventories
	<b>Current debt</b>
receivables accounts turnover	Net credit sales
	Average of receivables accounts
Inventory turnover	Cost of goods sold
	Average inventory
<b>Sale return</b>	<b>Net profit</b>
	<b>Net sale</b>
Average assets	<b>Net sale</b>
	Average assets
Average assets	<b>Net profit</b>
	Average assets
Return on common shareholders' equity	<b>Net profit</b>
	Average equity of shareholders
Dividend payout ratio	Cash dividends
	<b>Net profit</b>
The ratio of debt to total assets	<b>Total debt</b>
	Total Assets
The frequency of interest payments	Earnings before interest and taxes
	Interest expense

Based on the calculated ratios calculated regression line is estimated as follows:

$$eva = C + \beta_1 \text{TDPB} + \beta_2 \text{GHD} + \beta_3 \text{BHSS} + \beta_4 \text{NPS} + \beta_5 \text{GMK} + \beta_6 \text{quick} + \beta_7 \text{GD} + \beta_8 \text{BF} + \beta_9 \text{NBD} + \beta_{10} \text{BD} + \beta_{11} \text{current} \quad (7)$$

In this equation  $\beta$  is the factor coefficients that are estimated using data; C is Intercept of the regression line. Financial ratios are also displayed with the following symbols that can be observed in linear regression.

**Table 2: Financial ratios and their symbols**

Financial ratio	Symbol
<b>Current ratio</b>	current
<b>Future ratio</b>	quick
receivables accounts turnover	GHD
Inventory turnover	GMK
<b>Sale return</b>	BF
Circulating assets	GD
<b>Assets return</b>	BD
Return on common shareholders' equity	BHSS
Dividend payout ratio	NPS
The ratio of debt to total assets	NBD
The frequency of interest payments	TDPB

**Research Hypotheses**

*First hypothesis:* the combination of ANN and financial ratios has the ability to predict the economic added value.

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*The second hypothesis:* the model presented in this study provides better performance than the linear regression to predict the economic added value.

**Study Population and Statistical Sample**

The population of this study is all companies operating in the pharmaceuticals industry accepted in Tehran Stock Exchange (Capital Market of Iran). Of 9 companies with available information, the example was considered.

**RESULTS AND DISCUSSION**

For data analysis, we first entered all data into an Excel spreadsheet and then by using of the various functions and programming in Excel started to calculate them. After calculating all cases, including capital and nopat and the growth rate of capital, we calculate the weights.

Financial ratios are calculated using information from the financial statements. The following financial ratios are calculated:

- current ratio
- Quick Ratio
- Receivable accounts turnover
- Inventory turnover
- Return on Sales
- circulating assets
- ROA
- return on common shareholders' equity
- Dividend payout ratio
- ratio of debt to total assets
- frequency of interest payments

After calculating all the data and all the required cases, data entered into SPSS pages.

**Prediction by using Regression**

After entering data into spss software using linear regression and its function, we fit them with the regression line. The following table shows the output of the software.

**Table 3: Analysis of variance**

ANOVA <sup>b</sup>						
Model	Sum of Squares	df	Mean Square	F	Sig.	
1 Regression	4.286E13	11	3.896E12	3.515	.003 <sup>a</sup>	
Residual	3.325E13	30	1.108E12			
Total	7.611E13	41				

a. Predictors: (Constant), TDPB, current, BF, BHSS, GHD, NPS, GD, NBD, GMK, quick, BD

b. Dependent Variable: EVA

Based on the F-statistics, since the value of this statistic is more than the defined parameter, its value is placed in the critical region and assuming of no regression significance is rejected and at the 95% significance level, we can say the regression is significant.

Based on the P-value that its amount is more than 0.003 can be said that at 90, 95 and 99 percent has overall significance.

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**Table 4: Estimation of regression coefficients**

Model	Unstandardized Coefficients		Standardized Coefficients Beta	t	Sig.
	B	Std. Error			
1 (Constant)	613082.243	10501709.501		-.125	.902
current	-464335.890	755904.170	4.176	1.220	.232
quick	1503714.742	1130572.007	4.419	.865	.394
GHD	-5542.301	823227.195	-12.147	-3.274	.003
GMK	-319597.552	947137.603	1.770	.409	.685
BF	2823558.343	926547.397	-.402	-.094	.926
GD	824388.385	1100007.346	3.834	.755	.456
BD	-2363386.558	1242045.222	-2.166	-.373	.712
BHSS	80495.842	731509.216	-4.001	-1.170	.251
NPS	-11661.669	853817.199	-.983	-.244	.809
NBD	-154514.153	923299.192	12.479	2.872	.007
TDPB	-245.206	646671.303	-6.501	-2.134	.041

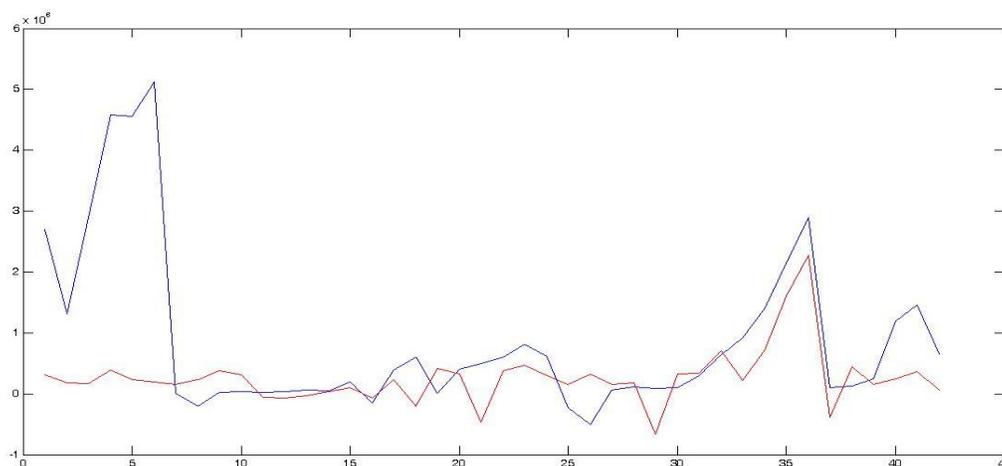
The regression line is obtained as follows:

$$eva = C + \beta_1 TDPB + \beta_2 GHD + \beta_3 BHSS + \beta_4 NPS + \beta_5 GMK + \beta_6 quick + \beta_7 GD + \beta_8 BF + \beta_9 NBD + \beta_{10} BD + \beta_{11} current \quad (8)$$

After insertion of the coefficients in the above formula, we have:

$$eva = 613082.24 - 245.206TDPB - 5542.301GHD + 80495.842BHSS - 11661.669NPS + 319597.55 GMK + 1503714.7 quick + 824388.39GD, +2823558.3BF - 154514.15NBD - 2363386.6 BD + -464335.89 current \quad (8)$$

After estimation of regression to predict and calculate the error of the data and can plot the graphs by using MATLAB software.



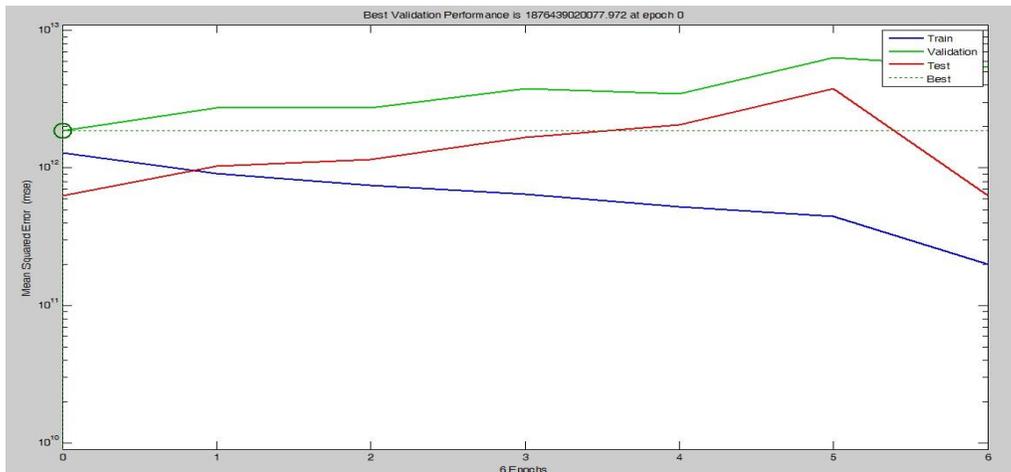
**Figure 1: Linear regression curve**

As you can see the regression error rate in cases where the variance is greater the error is greater too.

Prediction of EVA using neural networks

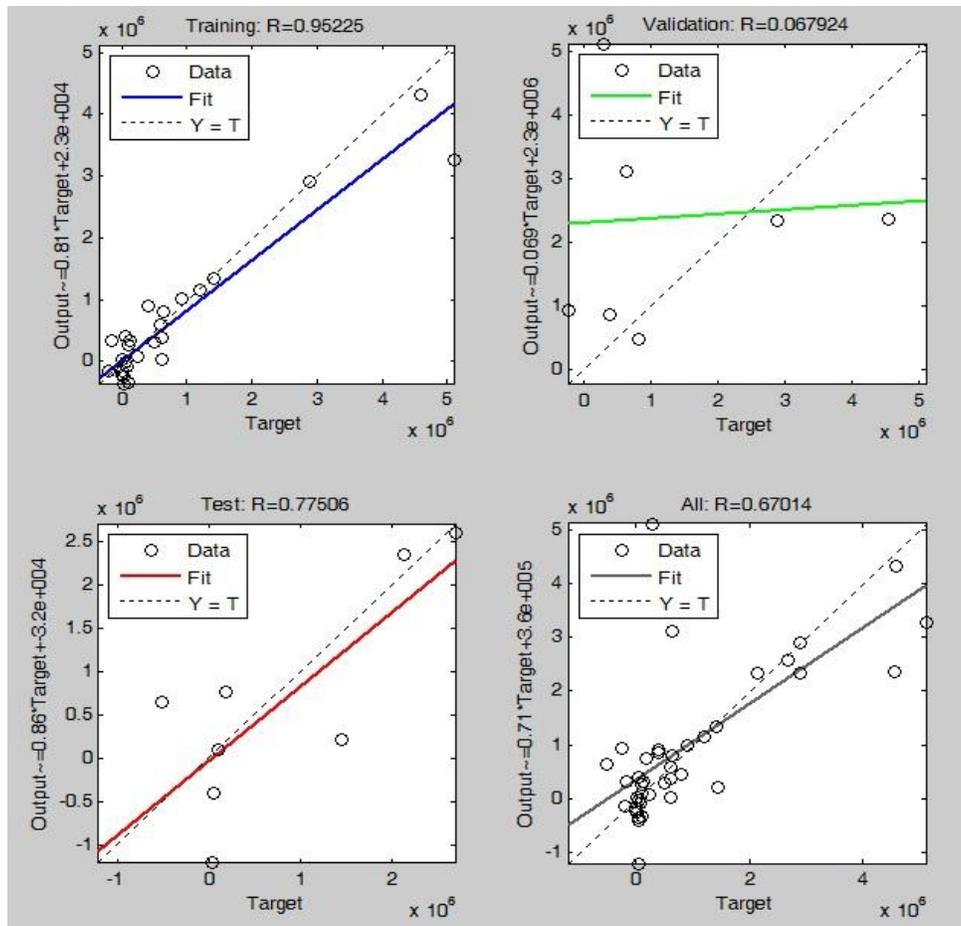
First by using MATLAB toolbox we plan neural network design. Input data of network that are financial ratios are also introduced to the network and determine for it. Now by using this, network toolbox should be trained. Network training with Levenberg - Marco LM train has been done.

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**Figure 2: Levenberg - Marco Diagram**

After training we see that at different times of education the best taught is selected. Here 6 times the act of learning is done. Learning at the first time was better than other times. So the first set is selected as the learning of network.



**Figure 3: Diagram of neural network training**

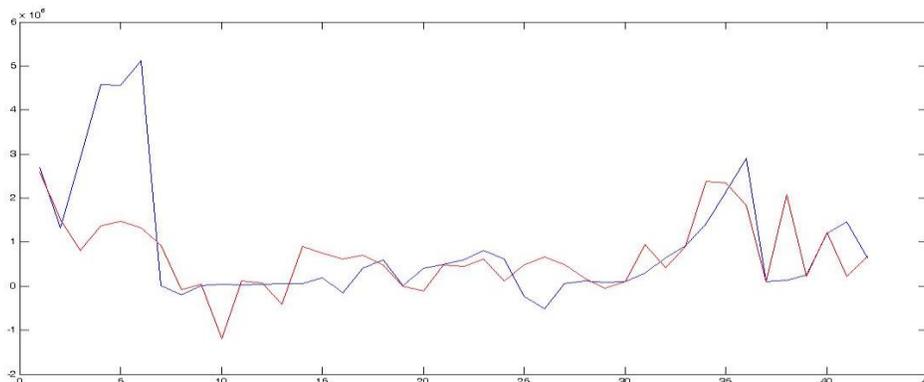
The optimal level of learning is displayed in form of diagram. It matches the goodness of fit and the input data and target.

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The training results of neural network are the network weights set on the communication lines between neurons and other parts both the input and output. The weights between input and hidden layer are shown in the table below.

According to the weights in the table can predict the economic added value. Following diagram represents the network prediction based on input data and comparing them with the actual values.

The red curve predicted by the neural network and the blue curve is the actual values.



**Figure 4: Diagram showing the predicted network based on input data and comparing them with the actual values**

**Comparison of Neural Network and Regression Forecasting**

To compare the two approaches should use an indicator. The study compared two approaches by using minimum squared error mean. The error in prediction means the distance between the predicted and actual values. What we anticipated be closer to the true value our forecast is better. In the table below you can see the actual and predicted values.

**Table 5: The actual and predicted values**

Neural network	Regression	actual			
2588412	444534	921006.7	995160.5	2693862	605353.2
1510402	607192.1	790774.7	1080195	1316185	813606.1
809912.4	118993.7	785794.2	915303.1	2893530	609033.2
1370524	471081.2	997552.7	767070.6	4582747	-232502
1469583	654372.5	841832.3	931651	4557681	-508884
1326516	487489.9	808850.7	763629.7	5119305	60454.79
932492.7	179186.7	771525.4	789184.8	5767.49	109990.9
-74614	-46918.1	841383.5	-52148	-203285	87685.76
46234.97	97591.76	993677.3	935611.8	17997.08	99732.06
-1200640	946633.7	930086.6	945770.3	37804.39	303698.9
111613.2	422911.5	554843.9	1324634	24190.29	643321.9
75570.87	906908.8	544144.7	838536.3	36692.1	920356.1
-409399	2378703	583278.4	1327153	59830.15	1409183
906062.5	2345335	654203	2210940	50620.64	2139221
756334.5	1839623	708267.6	2885570	195163.7	2896572
618245.5	98014.58	544857.2	230093.3	-154624	102848.6
707163.4	2069548	841716.1	1059841	396683.9	133547.3
474278.8	223201.4	411050.7	770359.4	601644.7	245267.6
-1093.38	1214243	1032403	859367.7	9004.92	1198961
-106553	220624.2	937937.7	984062.3	406152	1458937
480200.3	668135.1	145504.8	672318.5	499669.4	650079.7

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After the calculation, the model was used as a proxy to predict prices. At last the obtained models were compared to each other to select the optimal model; the tools of square root of the mean errors are used as the comparing tool. At first the error of each method was calculated and then RMSE was computed and according to it the results are obtained. In anticipation, generally the forecast is considered desirable that has smaller error. Error in forecast is shown by e. The error is said the distance between the actual value and the estimated. Once you've done the estimates using the software Excel 2010 we find between estimates and reality. As we call this distance error. To be able to compare the estimates of the rooted mean square error or RMSE is used. Each of the estimates that have smaller RMSE is more desirable.

$$RMSE = \sqrt{\frac{\sum [actualvalue - predictedvalue]^2}{number}} \tag{10}$$

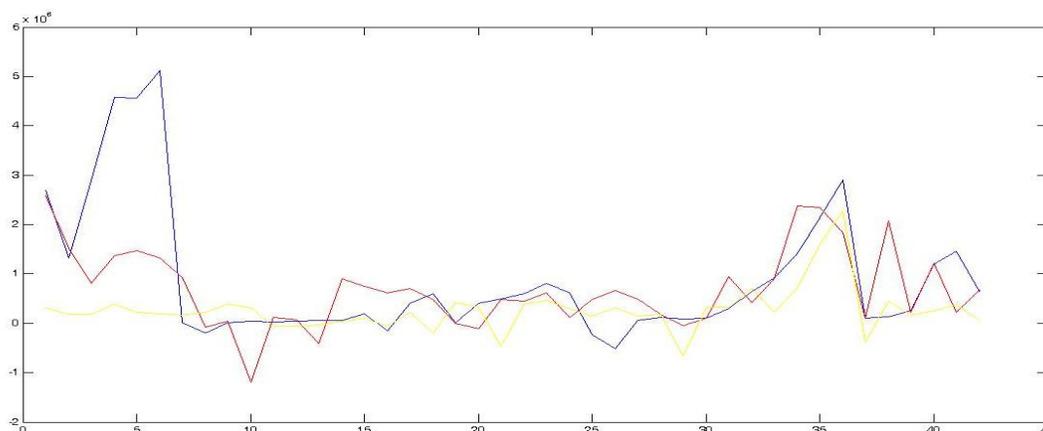
**Table 6: Comparison of network and linear regression error**

reg error		net error	
3143016716407	151949753000	11119730619	25862824533
276056427831	71069717445	37720077973	42606741128
4442551118802	93801269190	4341463309723	240138733828
12853620478817	999144353796	10318377405610	495028647361
13807529400374	2075139786710	9536349819146	1353164712505
18580018462753	494454917665	14385248933881	182358966380
586385242203	461304372541	858819574360	4788057553
1091332172277	19553492030	16556194001	18118189547
951951934835	698694962202	797378692	4580885
796167462933	412255769821	1533745023138	413365278432
281593242999	464186762739	7642772750	48580720123
257508147829	6694473825	1511558692	180830625
273998048787	6728897086	220176442822	939968400474
364311677218	5143613633	731780772492	42483155983
263275583838	121042703	314912715540	1117140965855
489273290328	16191231731	597326544393	23367421
198053661338	858019374365	96397566737	3748099142996
36326064628	275721372478	16222082457	486914730
1047344610194	115323293359	101975610	233566251
282796062145	225505975869	262866298537	1533418755323
125432590130	494562373	379043611	325998654
rmse	1268670.483	1128588.391	

As you can see the network error is less than the error of linear regression. This can be said due to more nonlinear move of neural networks than the regression method.

According to the table above, we can say that our first hypothesis is accepted because we have been able to use financial ratios and neural network to forecast economic added value in our pharmaceutical companies. As mentioned, much less RMSE of artificial neural network forecast shows better performance of this method than the linear regression model.

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**Figure 5: Comparison of the predicted curve**

In this diagram, the blue is actual data, red is forecast of ANN and yellow is regression forecast. With regard to the arguments and assumptions in this study can be seen that the combination of ANN and financial ratios have predictability of economic added value. And according to the RMSE of each model, the presented model by neural network has better performance than the linear regression to predict the economic added value.

### Conclusion

Artificial neural network is a data processing system of idea of the humans' brain and handles the data processing to small and large data processors as an interconnected and parallel network to solve a problem. In these networks with programming knowledge, data structure is designed that can act as neurons. It is said node. After creating a network between the nodes and applying a learning algorithm, train the network. In the memory or neural network nodes have two states active (ON or 1) or inactive (OFF or 0) and each edge (synapses or connections between nodes) has a weight. Edges with positive weights stimulate or activate the next inactive nodes and edges with negative weights; disable or inhibits the next connected node (if active).

Financial ratios and neural network compound have the ability to predict EVA and neural network during 6 training phases can define the weights when we test the predicted values with the real have the smallest difference. For pharmaceutical companies prediction of EVA with non-linear models had better performance than predicted by the linear model. In general it can be concluded that the results of this study could be used in investment, appraisal and valuation of companies. Now the ability of neural network can be employed in this sector and by using it can have the implicit added value and other uses.

### REFERENCES

- Busse Jeffrey A, Goyal Amit and Wahal Sunil (2010).** Performance and Persistence in Institutional Investment Management. *the Journal of Finance* **Lxv**(2).
- Januskevicius Marius (2003).** Testing Stock Market Efficiency using Neural Networks: Case of Lithuania. Available: <http://www.SSERIGA.EDG.LV> [20 Apr 2004].
- Karyl QC et al., (2005).** A Comparison between Fama and Frenchs Model and Artificial Neural Network in Predicating the Chinese stock market. *Computer and Operations Research* **32** 2499-2512.
- Leung Mark, An-Sing Chen and Hazem Daouk (2001).** Application of Neural Networks to an Emerging Financial Market: Forecasting and Trading The Taiwan Stock Index, Available: [www.webuser.Bus.Umich.Edu/hdaouk.Com](http://www.webuser.Bus.Umich.Edu/hdaouk.Com).
- Lev B (1974).** *Financial Statement Analysis: A New Approach*, first edition, New Jersey (Engelwood Cliffs: Prentic Hall).
- O'Byrne SF (1996).** EVA and Market Value. *Journal of Applied Corporate Finance* **9**(1) 116-125.

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**Omran M and Ragab A (2004).** Linear versus non-linear Relationships between Financial Ratios and stock Return. *Review of Accounting & Finance* **3**(2) 84-10.

**Pagach D and Warr R (2007).** An Empirical Investigation of the Characteristics of Firms Adopting Enterprise Risk Management. North Carolina State University Working Paper

**Stewart GB (1991).** *The Quest for Value: A Guide for Senior Managers* (Harper Business Publisher) New York.

**Uymeura DG, Kantor CC and Petit JM (1996).** EVA for Banks, Value Creation, Risk Management and Profitability Measurement. *Journal of Applied Corporate Finance* **9**(1) 94-109