MEASURING THE FINANCIAL EFFICIENCY OF COMPANIES IN THE PHARMA INDUSTRY WITH DEA METHOD AND ITS RELATIONSHIP WITH STOCK RETURNS

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Abstract: One of the accepted principles of financial management is that the main and fundamental purpose of companies' management is to maximize the stockholders' wealth through optimal allocation of company resources. Since the beginning of the twentieth century, traditional accounting criteria such as earnings of each share, return on assets and return on equity have been used to operationalize such concept. The primary purpose of this research is an investigation of the relation between the companies' comparative financial efficiency and their stock returns with data envelopment analysis method. To this end, active pharmaceutical products and related material companies in Tehran Stock Exchange are investigated among 2011 to 2014. Regression is used to test the hypothesis. The findings of the hypothesis tests show there is a significant and partly permanent relation between stock returns and efficiency with data envelopment analysis in this period.

Keywords: Stock returns, efficiency, Data envelopment analysis, constant returns to scale, variable returns to scale

1. Introduction

During the last few decades, growth strategies and industrial developments are affected by two factors that are growth and capital accrual and augmentation of performance and efficiency in industry section. Scarcity and lack of manufacturing factors especially capital in developing countries has made the augmentation of performance and efficiency quite important in economic growth process in that the development strategies and effective growth has promoted efficiency and performance in various economical sections. One of the most common parameters by which potency of industrial activities to gain comparative advantages among various industries is revealed, is considered efficiency level and its promotion. Undoubtedly, efficiency augmentation in an industry by reducing average cost of the goods and service production causes a decrease in prices and subsequently an increase in the profitability amount of final products in industrial production entity. The result is an enhancement of competitive power of local products in foreign markets and an increase in the volume of new industrial investment (Chien and Douw, 2015; Feroz and Raab, 2012).

Today, efficiency measurement is done through different methods. Data envelopment analysis is one of the powerful management instruments which can help management out to get organization toward higher goals and optimization and allocation of sources and profitability as well (Feroz and Raab, 2012). This method gives managers an instrument by which they can evaluate their company performance against other competitors and then based on its result they can decide for promising future. (figure1)

2. Statement of the problem

Men has always been interested to make his life easier and better and all his effort has been to optimize the result through the minimum available facilities to create value added. It is way obvious that due to the restriction of available resources, man always pays attention to get more output with higher quantity and quality. Hence, the measurement of efficiency has always been an important management issue. What makes a defense body of an economical entity strong that surpass other competitors is a sharp vision of the entity decision makers to recognize the weak and strong points as well as remove the flaws and promote the strengths in the whole entity, by creating an appropriate infrastructure. (Khajavi et al., 2010; Khajavi et al., 2005; Kodadad Hoseini and Shahtahmasbi, 2012)

It has always been significant to study the relation between the companies' efficiency with their stock returns and determine proper methods to measure the efficiency in various researches. Due to the use of mathematical techniques, avoiding the mental practices and personalization and high accuracy to reach conclusion, data envelopment analysis method is one of the most principle methods that has particular scientific place in recent decades. Therefore, the decision maker sections utilize this method widely in order to evaluate the efficiency (Mehregan, 2013). So in this research two questions will be raised:

1. What is the relation between company's financial efficiency (analysis via DEA method) and stock returns?
2. What is the difference between the calculation of efficiency model via BCC and CCR method and its relation to stock returns?

2.1 Research purpose

The main purpose of this research is to find a relation between the financial efficiency and stock returns in pharmaceutical product and related material industry in order to find practical solutions in our investment beside stock returns.
In other words, if an investment in an efficient economical agency accompanies with stock returns, it can increase the stockholder wealth. It is quite important to know the relation between these two variables though.

The main hypothesis of research

- There is a relation between comparative efficiency of the active pharmaceutical product and related material companies presented in stock exchange and their stock returns.

The secondary hypothesizes of the research
1. There is a relation between companies' stock returns and CCR model efficiency.
2. There is a relation between companies' stock returns and BCC model efficiency.
3. The stock returns in efficient companies are not equal with inefficient ones.

2.2 The research variables

A. Computational variables:
- Input (Input indexes):
1. Operating expenses
2. Fixed assets
- Output (output indexes)
1. Operating profit
2. Operating cash flaw

B. Statistical variables:
1. Independent variable: Efficiency
2. Dependent variable: return

Research conceptual and administrative model is illustrated in figure 1. Research style is based on the Inferential descriptive, correlation type.

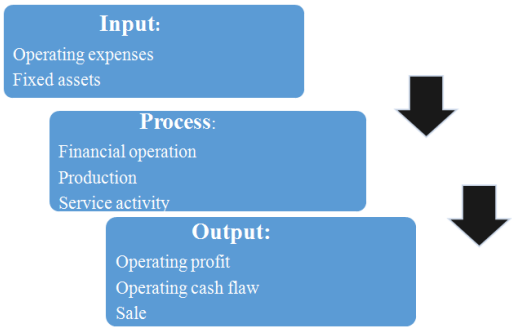

Figure 1. Conceptual model of data envelopment analysis cycle

2.3 Research thematic domain

The measurement of comparative financial efficiency with regard to active pharmaceutical products and related material companies accepted in Tehran stock exchange in data envelopment analysis method and investigating its relation with stock returns. Active pharmaceutical products and related material companies in Tehran stock exchange

2.4 Statistical society and sampling method

Statistical society of this research include all active pharmaceutical products and related material companies in Tehran stock exchange. Samples have been selected in systematic elimination method. Therefore, 18 companies have been selected as purposive sample among 26 pharmaceutical products and related material companies from 2011 to 2014. Library resources, articles, books, thesis researches and different websites have been used in order to collect information regarding theoretical principles and research literature and subject.

3. Data analysis method

After the company's financial efficiency via data envelopment analysis has been measured, its stock returns have been calculated as well and subsequently the relation between these two variable has been investigated**.**

3.1 Selecting the appropriate model to evaluate companies' efficiency

After the intended inputs and outputs have been recognized, we need to find the appropriate DEA model. Through solving DEA model, efficiency of each decision-making entities (DMU) will be measured based on the related inputs and outputs. One of the most significant goals in this research is ranking the decision-making entities; therefore if we can release the entities from restrictions in order to get efficiency (more than one) as much as they can, we will be able to separate them far from their efficient envelopment level which necessitates using a super-efficient model (Anderson Peterson method). In order to adjust efficiency and performance, both inputs and outputs can be varied. In some cases, making changes in outputs is easier while in other ones making changes in inputs is much simpler (Kodadad Hoseini and Shahtahmasbi, 2012) Hence according to the model, input or output approaches will be used for model solution. In the study of active pharmaceutical products and related material companies in Tehran stock exchange, because of the inputs nature and its manageability, selecting BCC and CCR input is the best option in order to measure the efficiency of the evaluated companies.(Mehregan, 2013; Mohammady, 2013; Seong-Jong, and Keebler, 2013)

3.2 DEA Performance Method

Performance steps in this research include two parts as A and B which is as follows:

After CCR and BCC were performed and compared in part a, types of efficiency in scale of decision making entities will become clear. In part B, after CCR model was performed, companies that have scored one in efficiency will be ranked based on Anderson-Peterson model (Mohammady, 2013). In Anderson-Peterson model, based on investigated entities, limitations are removed so that the entity can get more than one in efficiency score and eventually entities will be ranked from high to low. (Shahooth and Battelle, 2014)

Companies input and output data will be analyzed based on output BCC model, then the companies will be ranked. All calculations have been done by DeaP and DEA Solver software.

4. Results

Measuring companies' comparative financial efficiency is conducted through data envelopment analysis. After the information related to inputs and outputs of data envelopment analysis was extracted, the companies' efficiency level was determined by the mentioned software. The steps are as follows:

1. Ranking companies with input oriented CCR: Companies input and output data with input oriented CCR is analyzed and then companies are ranked. In the table1, efficiency level of each company have been calculated per four years. (Feroz and Raab, 2012).

Table 1. The calculation of the company's efficiency (input oriented CCR)

company	efficiency			
	2012	2013	2014	2015
Cosar Pharmaceutical Co.	0.2984184	1	0.1483847	0.1353972
Osveh Pharmaceutical Co.	1	1	0.5962948	0.6501159
Farabi Pharmaceutical Co.	0.3096573	0.3641576	0.2869898	0.3556246
Sobhan Darou Co.	0.5149289	1	1	0.2815705
Loghman Pharmaceutical Co.	1	1	1	1
Pars Darou Co.	0.4052165	0.46277	0.3098395	0.367056
Rooz Darou Pharmaceutical Co.	0.2762636	0.1857993	0.2298166	0.2193414
Exir Pharmaceutical Co.	0.3265454	0.3498342	0.2265657	0.6469968

Jaber Ebne Hayyan Pharmaceutical Co.	0.4725181	1	1	1
Alborz Darou Co.	0.2976419	0.7654277	0.5662146	0.9173136

In the table 2, the evaluated companies have been ranked based on the obtained efficiency score. As it is clear, companies such as Loqman, Osveh, Sobhan daroo and Jaber ibn Alhayyan have reached efficiency score one, over one year which shows these companies were able to retain their efficiency over time.

Table 2. Ranking companies (input oriented CCR)

company	**efficiency**			
	2012	**2013**	**2014**	**2015**
Cosar Pharmaceutical Co.	5	10	3	18
Osveh Pharmaceutical Co.	3	15	18	4
Farabi Pharmaceutical Co.	2	8	2	2
Sobhan Darou Co.	10	5	12	15
Loghman Pharmaceutical Co.	12	16	6	7
Pars Darou Co.	17	11	11	8
Rooz Darou Pharmaceutical Co.	14	3	9	16
Exir Pharmaceutical Co.	1	18	1	11
Jaber Ebne Hayyan Pharmaceutical Co.	11	1	17	10
Alborz Darou Co.	16	17	14	4

2. Ranking companies with input oriented BCC

Next, companies' efficiency with input oriented BCC can be seen. All efficiencies have been calculated for each four years separately in order to see company efficiency change over time. Finally, through efficiency average, the companies will be ranked. (Tables 3, 4)

Table 3. The calculation of the company's efficiency (input oriented BCC)

company	efficiency					
	2012	2013	2014	2015	Average efficiency	Overall Rank
Cosar Pharmaceutical Co.	0.4234228	1	0.2795438	0.2620069	0.4912434	15
Osveh Pharmaceutical Co.	1	1	0.6611885	0.6611411	0.8305824	9
Farabi Pharmaceutical Co.	0.3408334	0.440697	0.3690811	0.3710203	0.380408	17
Sobhan Darou Co.	0.5175828	1	1	0.3041088	0.7054229	11
Loghman Pharmaceutical Co.	1	1	1	1	1	1
Pars Darou Co.	0.4076104	0.5930593	0.3167724	0.3722524	0.4224236	16
Rooz Darou Pharmaceutical Co.	0.3088312	0.2436368	0.2474926	0.2271774	0.2567845	18
Exir Pharmaceutical Co.	0.5334347	0.5363887	0.3847134	0.6737693	0.5320765	14
Jaber Ebne Hayyan Pharmaceutical Co.	0.6473733	1	1	1	0.9118433	6
Alborz Darou Co.	0.373954	0.8145594	0.6219181	0.9305734	0.6852512	12

Table 4. Ranking companies (input oriented BCC)

company	efficiency			
	2012	2013	2014	2015
Cosar Pharmaceutical Co.	5	8	4	16
Osveh Pharmaceutical Co.	14	10	6	6
Farabi Pharmaceutical Co.	10	13	8	9
Sobhan Darou Co.	15	9	17	1
Loghman Pharmaceutical Co.	13	1	13	11
Pars Darou Co.	16	15	2	2
Rooz Darou Pharmaceutical Co.	8	12	10	12
Exir Pharmaceutical Co.	1	7	15	3
Jaber Ebne Hayyan Pharmaceutical Co.	4	16	3	17
Alborz Darou Co.	2	3	12	7

In the table5, return has been obtained compared to intended companies scale by DEA Solver software.

Table 5. Returns to scale of company

company	Type of Returns to scale			
	2012	2013	2014	2015
Cosar Pharmaceutical Co.	additive	fixed	additive	additive
Osveh Pharmaceutical Co.	fixed	fixed	additive	additive
Farabi Pharmaceutical Co.	additive	additive	additive	additive
Sobhan Darou Co.	decreasing	fixed	fixed	additive

Loghman Pharmaceutical Co.	fixed	fixed	fixed	fixed
Pars Darou Co.	additive	decreasing	additive	additive
Rooz Darou Pharmaceutical Co.	fixed	fixed	fixed	fixed
Exir Pharmaceutical Co.	additive	additive	additive	additive
Jaber Ebne Hayyan Pharmaceutical Co.	decreasing	fixed	fixed	fixed
Alborz Darou Co.	additive	additive	additive	decreasing

For companies faced with increasing return over scale, if there were an input increase possibility, they could utilize the economies of scale.

Because most companies' return over scale were varied (decreasing or increasing), BCC model is more appropriate to evaluate companies' efficiency. After that, the companies which have efficiency one for at least two years in BCC model with Anderson-Peterson model (Superefficient) will be evaluated in order to be ranked more accurately and their efficiencies will be calculated. The obtained results are in the table6. In the last column there is the four-year efficiency average. (Thore et al., 2011)

Table 6. Super efficient calculation table (Anderson-Peterson)

company	efficiency				
	2012	2013	2014	2015	Average efficiency
Cosar Pharmaceutical Co.	0.5452263	2.0415683	1.9150624	-0.838394	1.500619
Osveh Pharmaceutical Co.	3.002181	2.4053681	2.622131	2.5101016	2.6349454
Farabi Pharmaceutical Co.	0.8304402	1.4690041	5.5083173	1.2749391	2.2706752
Sobhan Darou Co.	1.280646	1.5767405	0.6524194	1	1.1274515
Loghman Pharmaceutical Co.	1	1.1858594	1.1588819	0.5596137	0.9760888
Pars Darou Co.	1.0317817	1.2698021	1.1793989	1.0312856	1.1280671
Rooz Darou Pharmaceutical Co.	1.0909121	1.3980806	1.2994392	1.6354465	1.3559696
Exir Pharmaceutical Co.	1.1337233	1.178556	0.2872226	0.0979365	0.6743596
Jaber Ebne Hayyan Pharmaceutical Co.	0.2913225	1.0514701	1.0797343	1.255028	0.9193887
Alborz Darou Co.	1.3424303	1.5805901	7.02843	-0.255864	3.3171501
Sobhan Pharma Group Co.	1	1	1	1	1
Iran Darou Co.	1.0843695	0.6867413	1.0087545	1	0.9449663
Zahravi Pharmaceutical Co	1.0638108	1.027298	1.192281	1.3676478	1.1627594
Kimi Darou Co.	1.046976	1.2998586	0.7644676	1.0574233	1.0421814
Abo Reyhan Pharmaceutical Co	0.4597935	1.2835759	1.1988004	-2.765988	0.0440455
Sina Pharmaceutical Co	9.9531374	1.0165473	4.1637344	1.1210478	4.0636167
Razak Pharmaceutical Co	0.5853602	1.1236185	1.0331864	0.6011799	0.8358363
Dr. Abidi Pharmaceutical Co	1.0514701	1.2994392	1.0312856	1.1588819	1.0909121

Now all information related to stock returns and efficiency based on data envelopment analysis has been determined. In this step the relation between stock returns and active pharmaceutical products and related material companies in Tehran stock exchange will be investigated.

5. Hypothesis test evaluation and description

5.1 The main hypothesis

Test result shows that there is a direct relation between the stock returns and the companies' efficiency. It means the more effort the managers make to increase their companies' efficiency; the higher stock returns will be experienced.

5.2 The first sub-hypothesis

Based on test findings, there is a direct relation between stock returns and the companies' efficiency with CCR method. It means the closer the efficiency is to number one, the better result they will have.

5.3 The second sub-hypothesis

Based on test findings, there is a direct relation between stock returns and the companies' efficiency with BCC method. It means the closer the efficiency is to number one, the better result they will have.

5.4 The third sub-hypothesis

In data envelopment analysis, the software outputs are between zero and one. If the calculated efficiency of a company equals one, the company is efficient, otherwise it is inefficient.

A limitation of data envelopment analysis method is if companies are efficient, they are all scored one that means they are efficient enough while their efficiency cannot be similar to each other in practice. Therefore, companies with efficiency score one for over a year are investigated with Anderson Peterson model beyond data envelopment analysis. Results of the test shows that significance level of the company return is more than 0.05 so its normality will be approved. Then variations were investigated using Levin test. (Khajavi et al., 2005; Kodadad Hoseini and Shahtahmasbi, 2012).

Test results represent that significance level of Levin test for all variations are over 0.05. So the hypothesis of equality of variations are approved.

Besides, the significance level of t Steve dent test for stock returns variation is less than 0.05 that rejects the hypothesis that efficient and inefficient companies returns are equal by %95 confidence. Regarding all mentioned issues, the hypothesis is accepted.

6. Conclusion

The hypothesis was tested for a period among 2011-2014 using Regression method. Findings show a significant and a stable relation between return and efficiency of the companies during

the given period. As a result, focusing on efficiency will increase stock return for the following year. According to the present research findings, following suggestions are proposed respectively:

To securities and exchange organization

It is proposed that a list of efficient and inefficient companies is presented to investors in order to direct investments in better ways as well as get them more profits.
It is proposed that efficiency and inefficiency is used as one of the evaluation standards in performance of accepted companies in securities and exchange organization.

To investors
It is proposed that as investors, they request this factor from those companies and projects in which they invest in order that they experience lower risks and more efficient investment.

To managers of this industry
Regarding to the deep effect of efficiency in obtained outcome of organization effort, it is proposed that managers include this criterion into their organization strategic plan.
Since the most significant part of inefficiency is because of ignoring education, survey work, timing and so on it is proposed that managers consider this important point that their stock returns and subsequently their investors will be increased with efficiency increase.

References

1. Chien, H. O., Douw, Z.: *Efficiency measurement of Taiwan's commercialbanks.* International journal of productivity and performance management, 2010, 85, 425-434.
2. Feroz, E. H., Raab, R. L.: *Financial statement analysis a Dataenvelopment analysis approach*. The Journal of the Operational Research Society, 2012, 54, 44-58.
3. Khajavi, S. H., Ghayuri, M., Ghaffari, M. J.: *Data Envelopment Analysis Technique: A complementary Method for Traditional Analysis of Financial Ratios.* Journal of the Accounting and Auditing Review, 2010, 17, 41-56.
4. Khajavi, S. H., Salimi, F., Rabie, M.: *Application of data envelopment analysis (DEA) in determining the portfolio of most effective companies listed in Tehran Stock Exchange*. Journal of Social Sciences and Humanities Shiraz University, 2005, 2, 32-43.
5. Kodadad Hoseini, S. H., Shahtahmasbi, E.: *surement and Sensitivity Analysis of Relative Efficiency in Non-Petroleum Exports of Iran and Selected Countries: A DEA Approach*. Journal of New Economy and Commerce, 2012, 23, 119-127.
6. Mehregan, M. R.: *Data Envelopment Analysis: Quantitative Models for Organizational Performance Evaluation*. Publisher: Ketab Daneshgahi, Tehran, Iran, 2013.
7. Mohammady, R.: *A data envelopment analyses approach based on total cost of ownership for supplier selection.* European journal of operational research, 2013, 85, 297-315.
8. Seong-Jong, J., Keebler, J.: *measuring the longitudinal performance of 3PL branch operation.* Benchmarking: An international journal, 2013, 20, 251-262.
9. Shahooth, K., Battelle, A. H.: *Using data envelopment analysis to measure cost efficiency with an application on Islamic banks.* Scientific Journal of administrative Development, 2014, 85, 156.
10. Thore, S., Kozmesky, G., Phillips, F.: *DEA of financial statements data the U.S computer industry.* The Journal of productivity analysis, 2011, 85, 229-248.