

The comparative study of ranking company's efficiency based on data envelopment analysis (DEA) and traditional methods (DuPont's method)

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Abstract—In this research, we combine the process of hierarchy analysis and data envelopment analysis (DEA) to eliminate the restriction of traditional analysis based on financial ratios.

At first we evaluate the expert's ideas in each industry by the process of hierarchy analysis the importance of different financial ratios were analyzed by the process of different financial ratios were analyzed by the process of hierarchy analysis. Company's relative efficiency was calculated by the combination of DEA and financial ratios, and the companies were ranked.

Statistical universe was the companies in three industries in SEC Tehran : cement, automobile and pharmacy.

Hypothesis was evaluated based on spearman's correlation coefficient. Ranking based on DEA and DuPont's method were compared. A significant difference was observed in DEA and DuPont's ranking.

The correlation was direct and its intensity was less than % 30.

Key words: efficiency, data envelopment analysis (DEA), Analytic hierarchy process (AHP), DuPont's method.

I. INTRODUCTION:

Analysis based on financial ratios for financial evaluation is nothing new. Every serious of ratios just evaluate one dimension and its financial ratios analysis drawback.

Every group of these ratios evaluate one dimension, such as organization's cash ability, profitability, growth or operation of corporation. Another drawback is that the importance of each set of ratios and their subsets are different.

For example, in set of cash ratios, it seems Acid test ratio, compare with other ratios, is more suitable for showing

company's cash ability. So financial ratios can't be a suitable guide for company's managers and investors. As a result, a method which summarized the set of datum will be helpful.

Today's in different fields such as accounting, management and economy, measurement is done by different methods. So interdisciplinary study is necessary. Because selection and utilization of the best method for efficiency measurement is very important.

Adel Azar (2007) studied the investor company's efficiency who operate in stock market since 1379.[1]

Hosien zadeh (2008) selected a combination of quantitative and qualitative approach for ranking Iran insurance agencies.[3]

Godsipiur (2002) ranked the active units by a combination of DEA and AHP approach in commercial companies.[2]

Namazi and Rostami (2007) presented a combination model for ranking decision making units in two steps by a quantitative and qualitative approach.[4]

Premachendra (2009) evaluated the performance of Greece banking system by DEA model. This model gas no input and just gas output some financial ratios are considered as a output bank.[6]

Seaford et al (2008) determined the efficiency of Chinese toy producer companies by DEA model , and studied the financial leverage effects on efficiency and efficiency-profitability relation ship.

Cia y,Wu w, (2001) studied costs of research and development effects on financial performance of companies which work on electric equipments and machinery in Japan They use DEA to affect of R&D experience on performance corporation.[7]

II. METHODOLOGIES :

This research is an applicable research and gas a descriptive – correlation nature.

By the purpose of financial statement evaluation , we use information banks of stock exchange organizations and SAHRA and TADBIRPARDAZ software's .

In this study we use 13 financial ratios which are grouped in four headlines : cash index, activity index, profitability index and growth index.

TABLE I. FINANCIAL RATIO COMBINATION

Index combination	Index 1	Index 2	Index 3	Index 4
Cash & liability Y ₁	Y ₁₁ Acid test ratio	Y ₁₂ Current asset ratio	Y ₁₃ Liability to-asset ratio	--
Profitability Y ₂	Y ₂₁ Gross profit ratio	Y ₂₂ Net income margin	Y ₂₃ Return of assets	Y ₂₄ Return of stockholders equity
Growth y ₃	Y ₃₁ Increase in stockholders	Y ₃₂ Increase in operational incom	Y ₃₃ Increase in sale	--
Activity y ₄	Y ₄₁ Turnover of account resivable	Y ₄₂ Turnover of inventory	Y ₄₃ Turnover of assets	---

III. VARIABLES MEASUREMENT

Every company's rank is measured by traditional methods of financial ratios and DEA for the purpose of hypothesis testing. For determination of relative financial ratios, financial index of every industry should be calculated. For example for current ratio calculation , equation 1 is presented , where y is average of main index j in compound index I , QA is current assets of the company i and LL is current debt of the company i.

$$\bar{y}_{ij} = \frac{\sum QA_i}{\sum LL_i} \quad (1)$$

IV. RELATIVE FINANCIAL RATIO ESTIMATION:

Relative amounts of indexes is calculated by these equations for their standardization equation 2 when a large amount of an index is favorable.

$$G_{ij}^m = \frac{y_{ij}^m}{\bar{y}_{ij}} \quad (2)$$

Equation 3 when small amount of an index is favorable.

$$G_{ij}^m = \frac{\bar{y}_{ij}}{y_{ij}^m} \quad (3)$$

Where y_{ij}^m = main index j in compound index I , \bar{y}_{ij} = average of main index j in compound index I

G_{ij}^m : relative amounts of main index j in compound index I, m: m th company.

A. *Compound index estimation* : each compound index includes several main indexes . each ratio has a different importance weight , so compound index can not be calculated by simply adding the indexes.

Compound index is calculated by weight and relative amounts of main index of m th company where y_{ij}^m = compound index i of m th company.

$$y_{ij}^m = \sum W_{ij} G_{ij}^m \quad (4)$$

W_{ij} = importance weight of main index j in compound index i.

G_{ij}^m = main index j in compound index.

B. *compound index estimation.*

By calculating compound index for every company, this vector is determined.

$$y^m = (y_1^m, y_2^m, y_3^m, y_4^m) \quad (5)$$

every company has 4 output compound indexes (y)

Which represent cash ability, profitability , growth and activity , respectively.

Companies in each industry were considered as n decision making units in DEA model, their relative efficiency was calculated and the companies were ranked . this model is a kind of collective model which acts according to company's output

$$Z_0 = \frac{1}{s} \sum \frac{s_i^+}{(y_{io} + s_i^+)} \quad (6)$$

s.t:

$$\sum_{j=1}^n y_{ij} \lambda_j - s_i^+ = y_0 \quad (7)$$

$$i=1,\dots,4 \quad j=1,\dots,4$$

$$\sum_{i=1}^m \lambda_j = 1$$

$$\lambda_j, s_i^+ \geq 0$$

V. CORRECTED AND COLLECTIVE DEA MODEL.

The results of companies efficiency ranking based on DEA and DuPont's models are presented for some companies.(table 2,3)

TABLE II. RANKING SOME CORPORATION- DEA MODEL

Pharmacy industry		Automobile industry		Cement industry	
Corporation	Rank	Corporation	Rank	Corporation	Rank
Rozdaro	1	Nasir	1	Nirize	1
Osveh	4	Mehvarsazan	4	Sofian	4
Amin	15	Traktor	15	Shahroud	15
Zaharavi	24	Irankodro	24	Garb	24

TABLE III. RANKING SOME CORPORATION-DUEPONT

Pharmacy industry		Automobile industry		Cement industry	
Corporation	Rank	Corporation	Rank	Corporation	Rank
razak	1	Zar	1	hormozgane	1
Osveh	4	zamiad	4	fars	4
hayyan	15	gataat outo	15	sharg	15
aborihan	24	sipadizel	24	hegmatan	24

VI. SURVEY POPULATION

Companies accepted in Tehran stock exchange are our, which are a Survey Population ccepted until 1387 , the end of their fiscal year is the end of esfand and they shouldn't be among the investment and intermediary financial companies

A. Statistical sample

Statistical sample was selected from 33 industries operate in Tehran stock market (330 companies) by random. Sample includes all active companies in 3 industries.

B. Statistical test of hypothesis

After companies ranking , correlation and meaningful relationship are studied.

At this stage the spearman's correlation coefficient is calculated. The sign of correlation coefficient determines the kind of relationship (direct or indirect)

It's meaningfulness is studied by p-value , p-value<0.05 shows a meaningful relationship

C. First hypothesis test

H_0 there is a significant difference between efficiency rankings based on DEA and DuPont's models in cement industry.

H_1 there isn't a significant difference between efficiency rankings based on DEA and DuPont's models in cement industry.

TABLE IV. HYPOTHESIS 1

R ²	P value	α
0.297	0.133	%5

$$H_0 : \rho = 0 \quad H_1 : \rho \neq 0$$

Correlation coefficient between ranking by these two modes is 0.297 , p-value is 0.133 which is >0.05 . so H_0 can't be rejected and by 95% assurance direct and meaningful relation ship is not confirmed . so H_1 is confirmed.

D. Second hypothesis test

H_0 = there is a significant difference between efficiency rankings based on DEA and DuPont's models in pharmacy industry.

H_1 : there is not a significant difference between efficiency rankings based on DEA and DuPont's models in pharmacy industry.

TABLE V. HYPOTHESIS 2

R ²	P value	α
0.245	0.209	%5

$$H_0 : \rho = 0 \quad H_1 : \rho \neq 0$$

Correlation coefficient between ranking by these two models is 0.245 , p-value is 0.209 which is >0.05. so H_0 can't be rejected and by 95% assurance direct and meaningful relation ship is not confirmed. So H_1 is confirmed.

E. *Third hypothesis test*

H_0 : there is a significant difference between efficiency rankings based on DEA and DuPont's models in automobile industry.

H_1 = there isn't a significant difference between efficiency ranking s based on DEA and DuPont's models in automobile industry.

TABLE VI. HYPOTHESIS 3

R^2	P value	α
0.245	0.239	%5

H_0 : $\rho = 0$ H_1 : $\rho \neq 0$

Correlation coefficient between ranking by these two models is 0.245 p-value is 0.239 which is > 0.05 so H_0 can't be rejected and by 95% assurance direct and meaningful relationship is not confirmed. So H_1 is confirmed

VII. CONCLUSIONS.

The result of 3 hypothesis test in cement automobile and pharmacy industries shows a significant difference between ranking by DEA and DuPont's models. The difference may originate from the way of studying .

In DuPont's model analysis is based on intuition aspect. DEA model is based on mathematical calculations, and personal ideas have no weight.

So these two models correlation is expected to be weak or there is no correlation.

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