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Studying the Performance Evaluation Results with Parametric and Non-Parametric Methods (Banking Industry)

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ABSTRACT

This paper aims to investigate the relationship between parametric and non-parametric models of performance evaluation, and explain the relationship between performance assessment models with SFA and DEA methods. Study of parametric and non-parametric assessment methods shows that choosing a performance evaluation method for decision units (DMU) depends on the nature of the data (Cardinal, Ordinal) in the inputs and outputs. In this paper, this relationship was obtained using the Spearman correlation test, the group statistic and comparison of couples. Spearman correlation test showed a significant and direct relationship between these two models and the results were quite similar. Distribution mean of evaluation results with DEA and SFA models show that the distribution of efficiency in branches is small and very close together, and efficiency of branches in both methods are very close together and have similarities. Mean difference in paired comparison test (two-sided) shows that the significance level is more than 5% and the two methods have the same results in calculation of the performance of the branches, and there is no significant difference. As a result of this study it was found that there is a significant relationship between the parametric and non-parametric assessment methods in the evaluation of Parsian Bank branches considering the pre-assessed results.

KEYWORDS: Efficiency, data envelopment analysis (DEA), stochastic frontier analysis (SFA)

1. INTRODUCTION

Man has always focused its economic efforts to achieve maximum results with minimal resources. The intention to achieve higher efficiency is called productivity. Productivity is a comprehensive concept and includes efficiency and increased productivity means improving living standards, prosperity, peace and welfare of humanity, which has always been considered by those involved in politics and economics. The concepts of efficiency and productivity have evolved following the human knowledge interaction in economics and its determination formed the basis for economic theories. To explain the concept of efficiency from economy point of view, it can be said that when an economic model produces goods and services from its resources in a way that in other circumstances others cannot achieve that much product, that economic model is efficient and its productivity is high. To determine the levels of efficiency and productivity, and to compare it, we need methods for evaluating performance. Obviously, the methods are determined based on the nature of the data as inputs and outputs. But apart from efficiency and productivity measurement for comparing the performance, many organizations by assessment of units look for different purposes, such as determine the effectiveness of managers, fitness of employees with their job, sharing bonuses, professional upgrade and so on.

Perhaps first we should answer why we assess. In fact, we can assess to valuate more accurately. The answer to the question why we measure is that we measure to plan and control confidently. Obviously, the planning and control of units under study is for their optimized management. In non-academic and administrative units to evaluate the performance there are various definitions depending on the type of activities. Some of the most widely accepted definitions in the industrial and institutional sectors which have been collected by interviews and conversations over a one-year field study are described below.

- Performance assessment is a process that measures and evaluates and values and judges performance during a given period.
- Performance evaluation in the organizational dimension is often synonymous with effectiveness of activities, and effectiveness means the level of which programs and goals are achieved while their activities and operations are effective.
- Performance evaluation describes ways to use resources in the form of performance indicators. The simplest definition of performance is the proportion of output data to input, thus performance evaluation system in fact examines the level of efficiency of management decisions regarding optimal use of resources and facilities.

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- In general performance evaluation system can be considered as the process of measurement, comparison of the level and method to achieve the desired state with certain criteria and attitude, in the certain scope and coverage with certain characteristics and in the given time period, aimed at its continuous review, modification and improvement.

There are common characteristics in the listed definitions that would indicate the desire for measurement, quantify and compare with the results in previous periods. So this paper decided to study and assess the evaluation results of parametric models (SFA model) [1] and non-parametric (DEA model) [2] as the two main branches of evaluation models. The aim of this study is to investigate the significant relationship between the evaluation results in Cardinal and Ordinal methods. While the decision maker can choose assessment methods, the nature of the inputs and outputs also bound the decision maker in choosing the evaluation method. To choose the best method for evaluating DMU, first the evaluation results of desired models shall be carefully considered. Now the question is that whether the output of parametric and non-parametric methods, regardless of the calculation methods and performance, yield similar output in results and DMUs rankings? Does DMUs' performance on the geometric axes emerged from the data have similar and identical slopes? If there is a significant correlation between the methods of data envelopment analysis (DEA) and Stochastic Frontier Analysis (SFA), it can be said that parametric and non-parametric methods do not differ for the decision maker in terms of the outputs, and mostly the ease and fit of the model is the main criterion for the decision maker to select the evaluated method.

The next section discusses the theoretical foundation and research literature on parametric (SFA model) and non-parametric (DEA model) models, with formulation and comparison of these two methods, and the need for research.

2 - LITERATURE REVIEW

In this section the theoretical foundation, research background and the necessity of research are presented.

2-1 - Theoretical Foundations

The first one who presented a method to measure performance was Farrell (1957) [3]. He recommended that the functions of an enterprise shall be assessed by comparing with the best firms in the same industry. It means that an indicator shall be designed as the efficiency or inefficiency indicator for comparison of a firm with the best firms in the same industry, and thus they are assessed. Performance as an indicator of economy is an indicator that is considered in most enterprises. In order to identify the strengths, weaknesses, threats and potential opportunities in a competitive environment, it is necessary to determine a series of concrete and overall measures to evaluate performance. As mentioned in the introduction, SFA model and DEA model are used as the two desired models in this paper.

Stochastic frontier analysis (SFA) method is a parametric method, and based on the economic theories is a quantitative model. Stochastic frontier analysis method is designed based on econometric models and theories of microeconomics. In this method using collected data and making certain assumptions, performance is measured in units. Stochastic frontier models compared to conventional econometric models is better in a sense that in fitness function the mean points are not considered and only border points are concerned. Aigner, Lovell, and others [4], Meeusen et al [5] independently established a stochastic frontier fault analysis structure to measure the productivity efficiency of a company. This method is proper for measuring the efficiency of industries with random input and output. This model needs a production function in the regression form and error distribution function type which is equal to the sum of the error components. Stochastic frontier analysis model is used to evaluate the performance of profitable organizations. Stochastic frontier analysis method is formulated as follows.

$\text{Ln}(q_i) = x_i \beta + v_i - u_i$

Where q_i, x_i, e_i in the output, input and error terms vector are for distribution of the i^{th} unit and respectively v_i is symmetric stochastic noise, u_i is asymmetric non-negative inefficiency and β is parametric vector that must be estimated. Relationship between technical efficiency and $-u_i$ is defined as $TE_i = \exp(-u_i)$. TE_i shows the technical efficiency [6].

Data envelopment analysis DEA [7] is based on a series of optimization using linear programming that is also called parametric method. In this method, the performance curve is created by a series of spots which are determined by linear programming. Linear programming method, after a series of optimization determines whether the decision maker units are on the performance line or out of it. Data envelopment analysis is a nonparametric technique that is appropriate for measuring the effectiveness of industries with different data such as multiple input and output. This method is used for performance evaluation of non-profit organizations, schools, hospitals, universities, courts, public service and agricultural sectors, etc. [8]. But in recent years, students have used it to assess the performance of commercial organizations. The formula of SBM model in data envelopment analysis technique which simultaneously reduces inputs and increases outputs is shown below [9].

$$\text{Max } p^* = 1 - 1/m \sum s_i^- / x_{io}, \quad (i = 1 \dots m)$$

$$1 + 1/s \sum s_r^+ / y_{ro} = 1, \quad (r = 1 \dots s)$$

$$X\lambda + s^- = x_o,$$

$$Y\lambda - s^+ = y_o,$$

$$\lambda \geq 0, s^- \geq 0, s^+ \geq 0.$$

Where,

m is amount of inputs, ***s*** is amount of outputs (this constraint will add after convert of fractional programming to linear programming),

$X \in R^{m*n}$,

$Y \in R^{s*n}$,

x_o plays the input role,

y_o plays the output role,

Late constraint shows that variables should not to be negative (λ, s^- and s^+).

In order to better understand the parametric (SFA model) and nonparametric models (DEA model) a comparison of these two methods by performance capabilities, weaknesses and applications approaches is shown on Table below.

Table (1) Comparison of methods of stochastic frontier analysis and data envelopment analysis

Stochastic Frontier Analysis (SFA)	**Data Envelopment Analysis (DEA)**
Consistency Both DEA and SFA methods are efficiency frontier analysis, and are similar in that they determine a frontier and inefficiency based on that frontier.	
Characteristic Parametric method	Non-Parametric method
Efficiency: Technical efficiency, scale elasticity, scale Measurement: efficiency, allocative efficiencies, technical change and TFP change	**Technical efficiency**: scale elasticity, scale efficiency, allocative efficiencies, congestion efficiencies, technical change and TFP change
Strengths: 1. It doesn't assume that all firms are efficient in advance. 2. SFA makes accommodation for statistical noise such as random variables of weather, luck, machine breakdown and other events beyond the control of firms, and measures error. 3. It doesn't need to price information available. 4. It is capable to hypothesis test. 5. To estimate the best technical efficiencies of firm, rather than average technical efficiencies of firm.	1. It doesn't assume that all firms are efficient in advance. 2. It could handle with efficiency measurement of multiple inputs and multiple outputs. 3. It doesn't need to price information available. 4. It does not need to assume function type and distribution type. 5. While sample size is small, it is compared with relative efficiency. 6. Both the CCR and BCC models have nature of unit invariance.
Weakness: 1. It needs to assume functional form and distribution type in advance. 2. It needs enough samples to avoid lack of degree of freedom. 3. The assumed distribution type is sensitive to assessing efficiency scores.	1. It doesn't make accommodation for statistical noise such as measure error. 2. It isn't capable to hypothesis test. 3. When the newly added DMU is an outlier, it could affect the efficiency measurement.
Application: It has applied to measure performance of profit organizations.	It has applied to assess performance of non-profit organizations or branches of firm.

Source: Coelli et. al. (1997), Lan et al. (2003). [8-9]

Following in this article the literature background on stochastic frontier analysis and data envelopment analysis models are presented.

2-2 - Research Background

About the application of stochastic frontier analysis and data envelopment analysis in library studies and search in the scientific World Wide Web, thousands of articles and various applications in many areas of business and service activities can be found. What is provided in this section as the research background is only selected from the excerpts research and applications of these two models in some business areas.

Kumbhakar, S.C., et al, (2000), Stochastic Frontier Analysis [10], Wadud, A. and others, (2000), Farm household efficiency in Bangladesh [11], Kohers, H., and others , (2000), Market perception of efficiency in Bank holding company mergers [12], Cullinane, K., and others, (2002), A Stochastic Frontier Model of the Efficiency of Major Container Terminals in Asia [13], Lan, L. W., and others, (2003), Measurement of Railways Productive

Efficiency with Data Envelopment Analysis and Stochastic Frontier Analysis [14], Bottaso. A, and others, (2003), cost Inefficiency in the English and Welsh Industry [15], Kumbhakar, S.C. and others, (2004), Markov switching stochastic frontier model [16], Cook, W.D., and others, (2005), evaluating power plant efficiency [17] , Farsi. M., and others, (2007), Cost Efficiency in the Swiss Gas Distribution Sector [18], Erbetta, F. and others, (2008), Optimal scale in the Italian gas distribution industry using data envelopment analysis [19], Jamasb, T., and others, (2001), Benchmarking and regulation [20], Resende, M., (2002), Relative efficiency measurement and prospects for yardstick competition in Brazilian electricity distribution [21], Pacudan, R., and others, (2002), Impact of energy efficiency policy to productive efficiency of electricity distribution industry in the Philippines [22], Jamasb, T., and others, (2003), International benchmarking and regulation: an application to European electricity distribution utilities [23], Giannakis, D., and others, (2005), Benchmarking and incentive regulation of quality of service [24], Chirwa, E. W., (2007), Sources of Technical Efficiency among Smallholder Maize Farmers in Southern Malawi [25], Al-hassan, S., (2008), Technical Efficiency of Rice Farmers in Northern Ghana [28], Lin, T.T., and others, (2009), Application of DEA in analyzing a bank`s operating performance [29] , Wouterse, F., (2010), Migration and technical efficiency in cereal production [30], Mugera, A., W., and others, (2011), Does Farm Size and Specialization Matter for Productive Efficiency? [31].

Table 2 compares the researches in the field of stochastic frontier analysis and data envelopment analysis in the historical order.

Table (2) Comparison of Studies

Researcher name	Year	Field of study
Kumbhakar, S.C. and others	2000	Stochastic Frontier Analysis
Wadud, A., and others	2000	Farm household efficiency in Bangladesh
Kohers, H., and others	2000	Market perception of efficiency in Bank holding company mergers
Jamasb, T., and others	2001	Benchmarking and regulation
Resende, M.	2002	Relative efficiency measurement and prospects for yardstick competition in Brazilian electricity distribution
Pacudan, R., and others	2002	Impact of energy efficiency policy to productive efficiency of electricity distribution industry in the Philippines
Cullinane, Kevin and others	2002	A Stochastic Frontier Model of the Efficiency of Major Container Terminals in Asia
Lan, L. W., and others,	2003	Measurement of Railways Productive Efficiency with Data Envelopment Analysis and Stochastic Frontier Analysis
Bottaso. A, and others	2003	cost Inefficiency in the English and Welsh Industry
Jamasb, T., and others	2003	International benchmarking and regulation: an application to European electricity distribution utilities
Kumbhakar, S.C. and others	2004	Markov switching stochastic frontier model
Giannakis, D. and others	2005	Benchmarking and incentive regulation of quality of service
Cook, W.D. and others	2005	evaluating power plant efficiency
Chirwa, E. W.	2007	Sources of Technical Efficiency among Smallholder Maize Farmers in Southern Malawi
Farsi. M., and others	2007	Cost Efficiency in the Swiss Gas Distribution Sector
Erbetta, F. and others	2008	Optimal scale in the Italian gas distribution industry using data envelopment analysis
Al-hassan, S.	2008	Technical Efficiency of Rice Farmers in Northern Ghana ،
Lin, T.T., and others	2009	Application of DEA in analyzing a bank`s operating performance
Wouterse, F.	2010	Migration and technical efficiency in cereal production
Mugera, A., W., and others	2011	Does Farm Size and Specialization Matter for Productive Efficiency?

2-3 - The necessity of research

Continuous improvement of organizational performance creates a force called synergy which provides a support for growth and development program and creates opportunities for the improvement of the organization. Governments, organizations and institutions work promptly in this case. Without studying and gaining knowledge about the progress and achievement of objectives, and without identifying the challenges facing the organization, and obtaining feedback and information on the implementation of policies developed, and identify issues that need serious improvement, the continuous performance improvement will not be possible. All this is impossible without measurement and assessment.

British physicist Lord Kelvin about measurements necessity says: whenever we could measure what we are talking about and expressed in terms of numbers, we can claim that we do know something about the subject. Otherwise, our knowledge is imperfect and will never reach maturity [32]. Thus, the compliance in the management science is estimated. What we cannot measure we cannot control and what we cannot control we would not be able to manage. The main theme in all organizational analysis is performance and its improvement requires measurement, and therefore an organization without performance measurement system will not be able to compete in the future arena. Here choosing a model and evaluation method is one of the most important problems facing decision-makers. This paper aims to study the relationship between parametric and non-parametric models and tries

to be a guide for the selection of an appropriate assessment models for decision-makers. Research methodology is discussed in the next section.

3 - RESEARCH METHODOLOGY

The paper in terms of purpose is an applied research, and in terms of data collection is a library research, and in terms of method is an association research. Data and information needed for studies are collected by library research method, documentation directory, and information about research variables are extracted by referring to the available resources and previous articles related to performance evaluation of Parsian Bank. Information related to research variables has been studied in a single period, and all branches of Parsian Bank were evaluated at the same time. In this study, in order to determine the reliability of the variables used in various forms of production function, the reliability tests such as Dickey - Fuller unit root test is used. The aim of this study is to investigate the significant relationship between parametric (Stochastic Frontier Analysis) and non-parametric (Data Envelopment Analysis) evaluation methods.

- Hypothesis

The hypothesis is concluded from the main research question. The main research question is whether there is a significant relationship between parametric (Stochastic Frontier Analysis) and non-parametric (Data Envelopment Analysis) evaluation methods? In this regard, the research hypothesis is stated as follows.

H_0: There is a significant relationship between Stochastic Frontier Analysis and Data Envelopment Analysis.
H_1: There is no significant relationship between Stochastic Frontier Analysis and Data Envelopment Analysis.

3-1 Data Mining

For statistical test and determining the significant relation of the research hypothesis, the data by previous research in this area has been used [33]. In this paper the researcher in the assessment section used the stochastic frontier analysis method and used the below model for evaluation.

$\ln (y_i) = f (x_i, \beta) + v_i - u_i$

Where y_i is the numerical observed output of the i^{th} branch, f is the production function, x_i is the quantity vector used by the evaluated branch, β is the vector of estimation coefficients, v_i is error value, u_i is amount of non-negative random selection in efficiency calculation.

Evaluation section through Data Envelopment Analysis method, SBM model is used for modeling. The main model for evaluation of Parsian Bank branches, after converting the fractional model to linear model and logging data from previous researches, for the first DMU is given as follows [7]. Inputs and outputs of the DEA model are presented in table 3.

Table (3) the inputs and outputs of all the branches (DEA)

Branch	Inputs	Outputs
1	- Total personnel - Total operating costs - Total non-operating expenses	- Banking payment facility - Total operating revenues - Total non-operating income
⋮	⋮	⋮
36	- Total personnel - Total operating costs - Total non-operating expenses	- Banking payment facility - Total operating revenues - Total non-operating income

After determining the numerical values of the input and output of all the branches, values for the branch 1 as a sample in (DEA) linear programming models are entered and shown below. It recalls that the lack and excess amounts of resources are not considered in the model and the cost unit is thousand Rials.

*Max p * = 1-1/3 (13358 +556638 +1323.5)*
1 +1 / 3 (65478598 +712496.64 +1574.965) = 1,
λ (13358) + ... (654254) + s-
λ (556638) + ... (964587) + s-
λ (1323.5) + ... (5246.9) + s-
λ (65478598) + ... (85321672) - s +
λ (712496.64) + ... (543924.85) - s +
λ (1574.965) + ... (3521.584) - s +
λ ≥ 0, s-≥ 0, s + ≥ 0.

SFA model inputs and outputs are as follows.

- Input variables of SFA model

To specify the inputs, after various studies, the total volume of durable deposits investment, savings deposits, the number of human resources, and total fixed assets and other assets of the bank were used as inputs.

- Output variables of SFA model

The total volume of bank facilities includes all granted facilities and bank receivables minus the reserve of doubtful receivables.

Investments include short-term and long-term investments and bonds.

Deposits at other banks include receivables from the central bank and receivables from banks and credit institutions.

Off-balance sheet activities include the nominal value of activities outside the balance sheet or non-interest income (receives fee).

Also the dependent variables (the total cost of bank including interest paid to durable deposits and loan awards, personnel costs, administrative costs, depreciation costs and expenses of doubtful receivables) and other variables (size of the banks (total assets), market concentration power (deposit), out-of-balance sheet activities rates (off-balance sheet items to total assets ratio), employee productivity (the ratio of total assets to the number of employees) are also included in this model. Stochastic frontier cost function model is calculated as follows.

$ln\ TC_i = ln\ TC\ (q_i, p_i) + \varepsilon_i = u_i + v_i$

TC_i is the total cost

q_i is output vector

p_i is input vector

ε_i is disturbance expression

v_i and u_i are as the two separable sentences with a different probability distribution.

u_i is the non-negative random variable that shows the inefficiencies of costs and has truncated normal distribution in zero N (μ, σ_μ).

v_i is the random error sentence (disturbance sentence) which may be due to measurement error, or other unimportant variables that were not considered in the model, or are imposed to the economic unit by external shocks (out of control), and has a normal distribution.

A sample of calculations for the first branch is written below. The results of calculations for all branches are presented in the next section.

ln TC1 = ln 557961.5 (31265744, 45892125) + 9854 = 3547 + 547872

4 - Research Findings

The results of evaluation of 36 Parsian Bank branches, according to the calculations sample described in the previous section are presented in Table 4 [32].

Table 4 comparison of branches' assessment results and their classification by two methods of SFA and DEA

Branch	SFA method	Rank	DEA method	Rank
1	0.8035	12	0.664	14
2	0.7205	22	0.4267	29
3	0.7155	23	0.519	24
4	0.6445	28	0.556	22
5	0.6745	25	0.374	31
6	0.751	18	0.565	19
7	0.917	1	1.561	1
8	0.7465	19	0.798	8
9	0.6755	24	0.566	18
10	0.7655	16	0.317	36
11	0.568	31	0.515	25
12	0.514	32	0.570	17
13	0.8915	2	1.270	3
14	0.6595	26	0.699	12
15	0.857	5	0.503	26
16	0.5705	30	0.353	33
17	0.724	21	0.564	20
18	0.746	20	0.606	16
19	0.655	27	0.445	28

20	0.7995	13	0.364	32
21	0.889	3	0.987	5
22	0.4915	33	0.549	23
23	0.8505	7	0.671	13
24	0.7765	14	0.761	10
25	0.7955	13	0.975	6
26	0.7685	15	0.4262	30
27	0.8215	11	0.720	11
28	0.874	4	1.136	4
29	0.8245	10	0.953	7
30	0.613	29	0.557	21
31	0.8365	9	0.617	15
32	0.7525	17	0.791	9
33	0.8575	6	1.320	2
34	0.4515	34	0.324	35
35	0.3655	35	0.499	27
36	0.848	8	0.341	34

- Spearman correlation coefficient

To test the significant relationship between these two methods, the Spearman's correlation coefficient is used. The correlation coefficient is a measure used to determine the correlation between two variables. Pearson correlation shows the severity and type of relationship (direct or inverse). As noted, the correlation between the research variables will be estimated using the Spearman correlation coefficient. In order to calculate the ρ, the degree of importance of the members of the studied group on a variable is sorted in order of numbers and their arrangement importance on the other variable is explained without any order. Then the difference of ranks is squared, and using the following formula ρ value is determined:

$$p = 1 - [(6\Sigma D_i^2) / (N (N^2 - 1))]$$

In which D_i is the difference of rank and N is the number of observations. To perform these operations, the SPSS software will be used in this research. If the ranks match, Di2 $\sum$ will be zero and ρ value will be 1. If the fraction amount is 2, there is a perfect negative correlation between the two variables (-1) and if the numerator is 1, the value of ρ will be zero, therefore it can be concluded that the two variables are completely independent and each number between these two numbers and in the interval (1, -1), indicates the type and quantity of the relationship and influence of the independent variable on the dependent variable. As in this study, the used variables are ordinal; therefore, to examine the relationship between the variables, this test is used.

Spearman correlation coefficient test results are presented in Table 5.

Table (5) results of Spearman correlation coefficient

Independent variables	Correlation coefficient	Sig	Test result
DEA	0.561 (**)	0.000	There is a significant direct relationship

** Correlation is significant at the 0.01 level (2-tailed).

As it is observed, using SPSS software the correlation coefficient has been estimated 0.561 with two stars, which means that approximately 99% the two models are directly and significantly related. In other words, it can be said that the results of these two models are quite similar. Hence the H_0 hypothesis is confirmed.

- Group statistic

The mean dispersion in DEA and SFA models is respectively 0.6629 and 0.7302 and the standard deviation for evaluation data has been calculated respectively 0.29789 and 0.14438. The data show that the dispersion of efficiency of branches is less and their mean is more. This means that the results of branches efficiency are very close and their effectiveness is similar.

Test results of group statistic are presented in in Table 6 to determine the significant or non-significant difference.

Table (6) group statistics

Group	N	Mean	Std. Deviation
DEA	36	0.6629	0.29789
SFA	36	0.7302	0.14438

- Test for pair comparison

In this test observations related to non-independent samples are used, because it is possible that there is no real difference between the two populations in terms of the desired variable, but there are external sources which reject the H_0 hypothesis or real differences are covered by external factors.

Table 7 presents the pair comparison statistic test results to determine the 2-tailed significance level.

Table (7) 2-tailed paired comparison test

	Mean	Std. Deviation	t	df	Sig. (2-tailed)
DEA - SFA	-0.06534	0.25096	-1.562	35	0.127

Test for means differences of the two methods shows that the significance level (Sig. (2-tailed)) is more than 5% and the two methods have the same results in calculation of performance of the branches, and there is no significant difference.

5 - Conclusion and recommendations

Parametric methods are those inferential statistical methods that lay their assumption on relative distance levels and population parameters can be described by observing the sample. Simply put, to test the hypothesis with quantitative variables, parametric statistic is used. As quantitative variables have a quantitative nature and can achieve unit, they can achieve mean and standard deviation. Non-parametric methods are those statistical techniques that lay their assumption on nominal levels, ranks and tests which are difficult to interpret and their control is less possible.

Study of parametric and non-parametric methods shows that choosing a performance assessment method for decision making units (DMU) depends on the nature of data (Cardinal, Ordinal) in the inputs and outputs. Therefore, the aim of this paper was to study the relationship between these two methods. In this paper, using the Spearman correlation coefficient test, group statistic and pair comparison, this relationship was derived as follows.

- The Spearman correlation coefficient has been estimated 0.561, which means that approximately 99% the two models are directly and significantly related and the results of these two models are quite similar. Hence the H_0 hypothesis is confirmed.

- The mean dispersion in DEA and SFA models is respectively 0.6629 and 0.7302 and the standard deviation for evaluation data has been calculated respectively 0.29789 and 0.14438. The results show that the dispersion of efficiency of branches is very close and their mean is more. Thus the efficiency of branches in the two methods is very close.

- The means differences in pair comparison test (2-tailed) shows that the significance level (Sig. (2-tailed)) is more than 5% and the two methods have the same results in calculation of performance of the branches, and no significant difference has been observed.

In this paper the hypothesis (There is a significant relationship between Stochastic Frontier Analysis and Data Envelopment Analysis) has been proposed. According to test results it can be said that both parametric and non-parametric methods efficiently can evaluate the effectiveness of Parsian Bank branches and any method used to evaluate the effectiveness will have the same results. This similarity may be due to the selection of inputs and outputs in the calculated efficiency. Thus some suggestions are stated in the research proposal.

- Proposal

As parametric and non-parametric methods are different in the nature of the data, it is likely that in the selection of evaluation inputs and outputs these two groups of data (Cardinal, Ordinal) are not considered separately and somehow wrongly qualitative data have been converted to quantitative data. On the other hand it is likely that the inputs and outputs determined in the evaluation of banks are such that both parametric and non-parametric approaches to evaluate the effectiveness of Parsian Bank show the same results. Thus it is suggested that:

1 – It is possible that the data defined to assess the performance in both models are the same and are not separated based on parametric and non-parametric data. It is recommended that a list of inputs and outputs shall be reviewed and qualitative data that somehow have become numerical shall be revised and the model shall re-run.

2 – In the assessment by non-parametric method all qualitative inputs and outputs shall be excluded from the calculation and the model shall be defined based on quantitative data and re-evaluate them.

If the re-evaluation results are similar to the previous evaluation, it shows that both parametric and non-parametric methods will have the same results in the evaluation of Parsian Bank (according to the results of this paper).

- Suggestions for other researchers

1 – The researchers can use the correlation tests for more accuracy and reliability in their future researches in relation to other assessment methods, and define the optimized evaluation model of the related unit through the regression function, and study the results by comparing the calculated regression function to the optimized function.

2 - Desired units shall be assessed periodically and the process of each decision making unit shall be studied over time, so that the strengths and weaknesses of each unit are determined for definition of optimization projects.

3 - Evaluation of decision making units commonly encounters the opposition or bargain over the results. This produces the main disagreement of decision making unit managers in comparison the evaluation result of incoherent units. Thus it is better to design a certain evaluation method for every single decision making unit based on the nature of the data in that unit, so the results of comparison between heterologous units is neutralized, and each unit has its own independent assessment to consider.

4 - A comparative evaluation of the branches performance using parametric and nonparametric methods such as Organizational Excellence Model (EFQM), stochastic frontier function approach (SFA), balanced scorecard method (BSC), analytic hierarchy process (AHP), genetic programming (GP), regression and obtain more accurate results and a more efficient model for evaluating the performance of banks.

5 – Using integration methods of DEA / AHP and DEA / GP and DEA / BSC for performance evaluation and comparing with DEA method individually.

6 - Sensitivity analysis of input and output variables and calculating the role of each of the variables in performance of branches.

7 - In evaluation of bank branches, technical, technological, and managerial efficiencies, returns to scale and ... the accuracy and results of each one shall be analyzed separately.

REFERENCES

1 - Lan, L. W., L., Erwin TJ, (2003) Measurement of Railways Productive Efficiency with Data Envelopment Analysis and Stochastic Frontier Analysis, Journal of the Chinese Institute of Transportation, Vol. 15, No. 1, 49-78.

2 - Tongzon, Jose, (2001) Efficiency Measurement of Selected Australian and Other International Ports Using Data Envelopment Analysis, Transportation Research, Part A, Vol. 35, pp.107-122.

3 - Farrell, MJ, 1957, the measurement of productive efficiency. J. Royal Stat. Soc. A, 120.

4 - Aigner, D., C.A.K. Lovell and P. Schmidt, (1977), Formulation and estimation of stochastic frontier production models. J. Econ., 6: 21-37.

5 - Meeusen, W. and J. van den Broeck, (1977), Efficiency estimation from Cobb-Douglas production functions with composed error. Int. Econ. Rev., 18: 435-444.

6 - Kumbhakar Sc., Lovell, C.A.K. (2000), Stochastic Frontier Analysis, first ed., Cambridge University Press, UK.

7 - Cooper W.W, Sieford LM, Tone K. (2000), Data Envelopment Analysis: A comprehensive text with models, applications, references and DEA solver software., Kluwer Academic Publishers.

8 - Coelli, T. (1996), A Guide to FRONTIER Version 4.1: A Computer Program for Stochastic Frontier Production and Cost Function Estimation, CEPA Working Paper No. 96/07, Centre for Efficiency and Productivity Analysis, University of New England, Armidale.

9 - Tone K., (1994), A slacks-based measure of efficiency in data envelopment analysis. European Journal of Operational Research 2001; 130: 498-509.

10 - Coelli, T., Rao, D. S. P., & Battese, G. E. (1997), An Introduction to Efficiency and Productivity Analysis, Kluwer Academic Publishers, Boston.

11 - Lan, L. W., L., Erwin T.J. (2003), Measurement of Railways Productive Efficiency with Data Envelopment Analysis and Stochastic Frontier Analysis, Journal of the Chinese Institute of Transportation, Vol. 15, No. 1, 49 ~ 78.

12 - Kumbhakar, S.C., and Lovell, C.A.K. (2000), Stochastic Frontier Analysis, Cambridge University Press, New York.

13 - Wadud, A. and B. White, (2000), Farm household efficiency in Bangladesh: A comparison of stochastic frontier and DEA methods, Applied economy, No.32: pp.1665-1673.

14 - Kohers, H., M.H. Huang and N. Kohers, (2000), Market perception of efficiency in Bank holding company mergers: The roles of the DEA and SFA models in capturing merger potential. Rev. Financial Econ., 9: 101-120.

15 - Cullinane, Kevin, & Song, Dong-Wook, & Gray, R. (2002), A Stochastic Frontier Model of the Efficiency of Major Container Terminals in Asia: Assessing the Influence of Administrative and Ownership Structures, Transportation Research Part A, Vol. 36, 743 ~ 762.

16 - Lan, L. W., L., Erwin T.J. (2003), Measurement of Railways Productive Efficiency with Data Envelopment Analysis and Stochastic Frontier Analysis, Journal of the Chinese Institute of Transportation, Vol. 15, No. 1, 49 ~ 78.

17 - Bottaso. A, and conti. M. (2003), cost Inefficiency in the English and Welsh Industry: An Heteroskedastic Stochastic cost Frontier Approach, Working Paper, University of Geneva, Italy.

18 - Kumbhakar, S.C. and E.G. Tsionas, (2004), Markov switching stochastic frontier model. Econometrics J., 7: 398-425.

19 - Cook, W.D. and R.H. Green, (2005), evaluating power plant efficiency: A hierarchical model. Compute. Operations Res., 32: 813-823.

20 - Farsi. M., Filippini, M. and Kuenzle, M., (2007), Cost Efficiency in the Swiss Gas Distribution Sector, Energy Economics, Vol. 29, 64-78.

21 - Erbetta, F. and L. Rappuoli, (2008), Optimal scale in the Italian gas distribution industry using data envelopment analysis. Omega, 36: 325-336.

22 - Jamasb, T. and Pollitt, M., (2001), Benchmarking and regulation: international electricity experience, Utilities Policy, 9 (3), pp. 107 to 130.

23 - Resende, M., (2002), Relative efficiency measurement and prospects for yardstick competition in Brazilian electricity distribution, Energy Policy, (30), PP. 637 to 347.

24 - Pacudan, R. and Guzman, E., (2002), Impact of energy efficiency policy to productive efficiency of electricity distribution industry in the Philippines ", Energy Economics, 24, pp. 41-48.

25 - Jamasb, T. and Pollitt, M., (2003), International benchmarking and regulation: an application to European electricity distribution utilities ", Energy Policy, 31, pp. 121-130.

26 - Giannakis, D.; Jamasb, T. and Pollitt, M., (2005), Benchmarking and incentive regulation of quality of service: an application to the UK electricity distribution networks ", Energy Policy, 33, pp. 2256-2271.

27 - Chirwa, E. W. (2007), Sources of Technical Efficiency among Smallholder Maize Farmers in Southern Malawi. AERC Research Paper, No.172. African Economic Research Consortium, Nairobi.

28 - Al-hassan, S. (2008), Technical Efficiency of Rice Farmers in Northern Ghana. AERC Research Papers, African Research Consortium, Nairobi.

29 - Lin, T.T., C.C. Lee and T.F. Chiu, (2009), Application of dea in analyzing a bank `s operating performance. Expert Syst. Appl., 36: 8883-8891.

30 - Wouterse, F. (2010), Migration and technical efficiency in cereal production: evidence from Burkina Faso. Agricultural Economics 41 (5): 385-395.

31 - Mugera, A., W. & Langemeier, M., R. (2011), Does Farm Size and Specialization Matter for Productive Efficiency? Results from Kansas, Journal of Agricultural and Applied Economics 43 (4): 515-528.

32 - Chang, H. (2004), Inventing Temperature: Measurement and Scientific Progress. Oxford University Press, ISBN 0-19-517127-6.

33 - Ghasemi Nejad, N., Introduce an Optimum Model for Assessment of Performance of Parsian Bank; Parametric and Non-Parametric Approach, National Academy of Sciences of Tajikistan.