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Exploring Intellectual Capital

Evaluating the Productivity of Production Factors in Refah Bank in North Khorasan Province Using Malm Quist Index

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Abstract

The main purpose of this study is examining productivity and technical efficiency of production factors in Refah Bank branches using Malm Quist index and data envelopment analysis method. To this and, performance of 9 branches in North Khorasan province has been studied during 2009-2011 fiscal years. Totally, the results obtained from productivity variations of production factors using Malm Quist index show that total productivity of production factors during the studied period has enjoyed 1 percent growth average. Technological variations are important reasons of productivity growth in this period. Technical efficiency average of Refah Bank with input-based orientation assuming constant yield to the scale has been 0.851, 0.821 and 0.869 during studied years, respectively.

Keywords: Malm Quist index, distant function, data envelopment analysis, technical efficiency

1. Introduction

Productivity is considered as a culture and technique in all domains of human life and work, and the source of economic progress and development. This culture and perspective is such that by organizing activities, the best result is achieved.

Today, the role and importance of financial institutes is not hidden to anyone. In this context, one of the issues that one must move in line with organizing it, is the banking industry which is considered as one of the central activities in economic development of each country. So that

organizing this industry will prove the ground for promotion and optimized performance. Therefore, due to the influential role of banks in economic activities, studying their productivity and efficiency performance as sectors that their structure is as a large enterprise with several branches will be of great importance. Meanwhile, using tools for determining the level of productivity of branches such as Malm Quist indexs in evaluating total performance of production factors are among main methods of evaluating banks' performance.

Given the importance of research, measuring and determining productivity growth rate of Refah Bank Branches in North Khorasan province using Malm Quist index are among objectives of the present study.

To achieve research objectives, first, theoretical foundations and empirical research are discussed; then the research methodology is presented and the results of estimating total productivity of production factors in each of the studied branches are analyzed; the final section is devoted to the conclusion and providing suggestions.

2. Literature Review

2.1. The Concept Of Efficiency

So far, various definitions of efficiency have been presented. Efficiency in the general sense means the degree and quality of reaching optimal goals set (Farrell et al., 1985). Therefore, a manufacturer would be efficient if it could reach all productive goals that have been intended. Generally, the efficiency concept is used at three various levels of micro, industry or organization and macro.

Efficiency in economy means optimal allocation of resources, and efficiency evaluation is done at the two levels of firms and markets. In terms of applied objectives, a variety of definitions have been expressed. Generally, efficiency represents the ratio of output to inputs compared with a specified standard or the ratio of the actual obtained productivity to the standard and specified productivity (expected) and in the other words, the ratio of the amount of the work done (actual output) to the amount of the work to be done (specified output). Therefore, according to this definition, we have:

$$\text{efficiency} = \frac{\frac{\text{actual output}}{\text{actual input}}}{\frac{\text{specified output}}{\text{actual input}}} = \frac{\text{actual output}}{\text{optimal standard output}}$$

Farrell examines three types of efficiency; technical efficiency, allocate efficiency and economic efficiency

In this paper, technical efficiency is examined and explained. In technical efficiency, the relation is considered between input and products and how to convert inputs to products. This type of

efficiency is a relative concept; because the comparison between firms is in the type and technology use.

There are two concepts in this type of efficiency. By definition, the firm has higher technical efficiency that can produce more products than other firms with a given and constant data set. The discussion is centered on the production rate variation. Therefore, it is called output-centered efficiency. According to another definition, a firm is efficient when uses less of one or more production factors compared with other firms without increasing the amounts of other factors given the product constant level. This type of efficiency evaluation is called input-centered method.

Efficient production standard of a manufacturing unit is the maximum output that the manufacturing unit produces using specified inputs (theoretically). Although this definition can be the best and most accurate definition in terms of theory, its application will enjoy less accuracy when we are faced with complex process of production. In other words, in a complex production process, it is possible that theoretical efficient production function be estimated more optimistic than what in fact is possible. To avoid this deficiency, it's better to use the second definition in which the criterion and objective are considered as the best performance of similar units. In this method, the estimation of frontier production function is performed based on values of inputs and balanced observed outputs of the firm.

There are two major methods for determining the efficiency of banking units, which include:

1. Ration analysis method; 2. Frontier analysis method

Ration analysis method is one of the oldest methods of measuring efficiency in banking units. In this method, by calculating a series of financial indexs of banks and comparing these rations with the specified standards in the banking industry, the efficiency or inefficiency of the studied banks is commented.

In the frontier analysis method, first, banks create the efficiency border by estimating frontier production functions; and banks that are active in the border are known as efficient units and those that are located outside of it are considered as in efficient units.

Frontier analysis method includes two major methods of parametric and nonparametric, that these two methods are also divided into several types.

Types of parametric methods include: stochastic frontier approach, thick frontier approach and distribution-free approach

Types of nonparametric method include: observation method, step method, linear mean method, limit points connection method and data envelopment analysis method

In parametric methods, the efficiency of each bank is determined using frontier production function obtained from functions of production or cost of translog and Cobb-Douglas.

In these methods, due to the using econometric models, hypothesis testing is possible. The most important objection is that the possibility of stipulating a specific from is difficult for most functions in service activities unlike productive activities. Therefore, certain restrictions are created in estimations.

2.2. Productivity

Productivity is one of the important concepts in studies and examinations of firm's performance over time. Productivity can be measured in the three levels of individual, group or organization.

Productivity is a concept attributed to open systems as a very important feature; and its significance is such that it can be taken into account as the primary goal of any system.

In today's world, improving the productivity is considered as one of the national priorities of each country, because the continued economic vitality, economic growth and improving living standards of people in a community depend on improving productivity. Productivity growth in a community will increase gross domestic product; and since gross domestic product divided by population represents per capita income, thus efficiency improvement leads to increase in the divided wealth among members of society. Increase in the per capita income will lead to living standards growth and power of people in achieving more goods and services with better quality.

Several definitions have been proposed for productivity. Some of them are highly descriptive such that "productivity is the optimum use of human and material resources"; that based on this definition, measuring productivity is considered a very complicated and problematical issue.

Albert Aftalion (1911) defined productivity as the relationship between the amount of product obtained in a certain period and the amount of consumed factors in the production process of that product.

The following definitions have also been provided for productivity in the dictionary of economic sciences:

1. The ration between a certain amount of product and certain amount of one or more production factors

2. The amount of product that each worker can produce at any given time

3. Productivity is the relative amount efficiency

Some other definitions of productivity are as follows:

Organization for European Economic Cooperation (1950) called productivity as the ratio of return to one of production factors.

Davis (1955) defined productivity as increase in the product amount due to the resources used in that product.

Fabricant (1962) introduced productivity as the ratio between output and input which is according to the following fraction:

$$\text{productivity} = \frac{\text{(output) produced goods and services}}{\text{(input) consemed resources}}$$

And Somanth (1979) referred to tangible ratio to input as total productivity of production factors.

The productivity definitions from the perspective of international organizations and institutions are as follows:

International economic organizations and institutions have also provided several interpretations of productivity.

Japan Productivity Center writes in its charter in 1955: the aim of productivity improvement, firstly is to maximize use of resources, human resources, facilities, etc. scientifically, reduce production costs, expand markets, increase employment and effort to increase real wages such a way that is beneficial for worker, management and the public consumers.

International Labor Organization: productivity is the relationship between production return and one of its factors.

European Productivity Agency: while mentions productivity as an intellectual perspective and considers its aim as effort to improve the status quo, accepts degree of effective use of each of production factors as productivity definition.

If we want to express productivity as mathematical formulas, it can be formulated as:

$$\Pi_i = \frac{y_i}{x_i}$$

Means that productivity in each period equals to the product of firm at that period to its input amount.

Meanwhile productivity improvement meaning more effective use of resources, including: labor force, capital, land, materials, energy, machinery and tools, equipment and information in the production process of goods and services. In other words: all structured systematic efforts to eliminate or reduce the loss of materials, machinery, human and inappropriate interaction between them is called productivity improvement system.

Generally, concepts of productivity express a type of relationship between the amount of produced products and the amount of produced resources in their production process that this relationship is quantitative and measurable.

2.2.1.Types Of Productivity

1. Partial productivity: Partial productivity is the ratio of output to one of inputs.
For example: labor productivity which means the ratio of labor output to labor input is a partial productivity index.

2. Total factor productivity: Total factor productivity is the ratio of added value to the total labor and capital input factors. Added value is one of the most important economic variables used in measuring productivity. The total pure value of goods and services produced in an industrial unit during a financial period is called added value.

3. Total productivity: Total productivity is the ratio of total output or product to the sum of all input factors. This index reflects the joint effect of all inputs in producing output. Such that it can be said that the information needed for calculating this type of productivity is relatively difficult to achieve. Factors affecting productivity are based on the following chart:

Diagram (7-2): diagram of factors affecting productivity
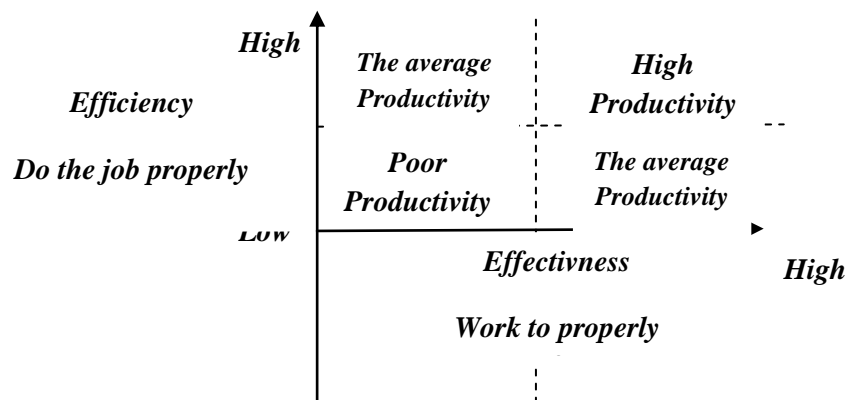
Determining product variations and production factors are very important for measuring productivity. Variations in single-product and single-input firms can be calculated easily. However, measuring productivity indexs is not an easy task in multi-product and multi-input firms. In order to measure productivity variations, numerical indexs are used to measure the amount of produced product and used production factor in two time periods for a firm; or two

firms in a time period. In a binary comparison, when two time periods or two firms are compared with each other, total factor productivity index is used.

It was due to the insufficiency of partial productivity indexs such as labor force productivity, capital and energy that Farrell stressed on measuring total factor productivity index.

Various methods through which total factor productivity can be measured are: input-output method, added value method, index method (which is divided into two Kendrick and Divizhya methods), Malm Quist method and Tern Quist method; in the present study, Malm Quist method has been used for measuring total production factor productivity.

2.2.2. Malm Quist Productivity Index

Until 1992, this index was not used much. In this year the first partical estimation was done with this method. In 1989, Farrell et al. used data envelopment analysis techniques in order to calculate Malm Quist index. Then, in 1992 they decomposed the index into two factors of efficiency change and technology change that this decomposition was presented in 1994 as FGNZ decomposition by Farrell et al. this decomposition had another factor named as scale change. In the following, model of Malm Quist index of productivity growth and how it decomposed into two factors of efficiency change and technology change are described.

Assume n is the decision maker unit. The purpose is to calculate Malm Quist productivity growth from t period (first period) to s period (second period) and decompose it to the three mentioned factors. Therefore assume the P-th unit is one of these units that in t period has $X^t = (X_1^t, X_2^t, \ldots, X_n^t)$ inputs and $y^t = (y_1^t, y_2^t, \ldots, y_m^t)$ Outputs; and in s period has $X^s = (X_1^s, X_2^s, \ldots, X_n^s)$ inputs and $y^s = (y_1^s, y_2^s, \ldots, y_m^s)$ outputs.

Diagram (3-3): the efficiency frontier of the first and second periods

Efficient frontier period s

Efficient frontier period t
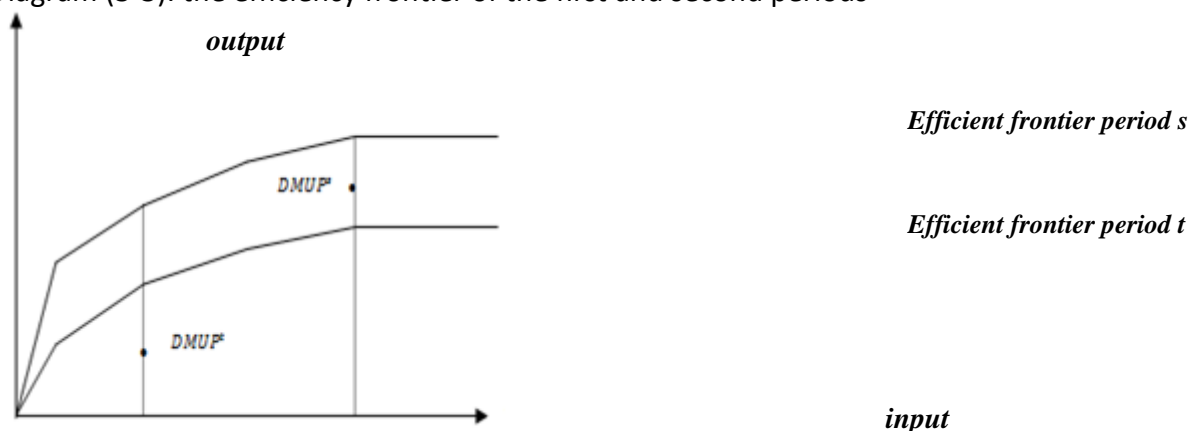
Given the definition of distant function and above assumptions, Malm Quist index (with output nature) is defined as follows:

$$M(X_s, X_t, y_s, y_t) = \left[\frac{d^t(X_s, y_s)}{d^t(X_t, y_t)} \times \frac{d^s(X_s, y_s)}{d^s(X_t, y_t)}\right]^{1/2}$$

That in the above relation: $d^t(X_s, Y_s)$ is TFP value of P-th unit in S period using the technology (frontier) of t period, $d^t(X_t, Y_t)$ is TFP value of P-th unit in t period using the technology (frontier) of t period; $d^s(X_s, Y_s)$ is TFP value of P-th unit is s period using the technology (Frontier) of s period; and $d^s(X_t, Y_t)$ is TFP value of P-th unit in t period using the technology (frontier) of s period.

But the above relation can be rewritten as follows:

$$M(X_s, X_t, y_s, y_t) = \frac{d^s(X_s, y_s)}{d^t(X_t, y_t)} \times \left[\frac{d^t(X_s, y_s)}{d^t(X_s, y_s)} \times \frac{d^t(X_t, y_t)}{d^s(X_t, y_t)}\right]^{1/2}$$

That in this relation, Malm Quist growth index has been decomposed into two factors of change in efficiency and change in technology:

$$EC = \frac{d^s(X_s, y_s)}{d^t(X_t, y_t)} \qquad \text{effieicncy change}$$

$$TC = \left[\frac{d^t(X_s, y_s)}{d^t(X_s, y_s)} \times \frac{d^t(X_t, y_t)}{d^s(X_t, y_t)}\right]^{1/2} \qquad \text{technology change}$$

After the calculation of Malm Quist index and decomposing it for each decision maker unit, if EC > 1 then the unit has had efficiency increase between the two periods, and when EC < 1 efficiency has been reduced. In other words, the value of EC represents the amount of efficiency share of a unit in productivity growth of total factors of that unit.

If TC > 1 then the unit has had improvement in technology and technical knowledge during the two periods; and when TC < 1 the issue will be vice versa. Therefore, TC represents the effect of technology and technical knowledge change in total factor productivity growth of the unit, and finally any value more than 1 in Malm Quist productivity growth indexs mean TFP growth in this unit in the consecutive period and values less than one indicate negative growth.

Malm Quist index advantages compared with other indexs introduced in this study are:
● It has less restrictive assumptions compared with other methods.
● in this method, value information has been used and economic estimates are not required. In other words, in the traditional methods of measuring productivity, restrictive assumptions such as minimizing cost or maximizing revenues are considered; and if there are incorrect observations or price information about share of costs or revenues, price information would be virtually useless. When a unit has multiple inputs or multiple outputs, some coefficients will be needed that must be chosen for each input compatible with its role in creating output. In fact, in this index there are not assumptions of cost minimizing or revenue maximizing, and only value observations of inputs and outputs are needed. Of course in case of price information, they can be used in Malm Quist method.
● No assumption is required in calculating Malm Quist productivity index.

● among other advantages of this method is evaluating productivity of each unit or firm against profile of the best unit according to the same data combination, and efficiency and technical progress resolution; while this is not possible in calculating growth with traditional methods.
● another advantage of Malm Quist index is that no particular assumption is introduced on the production function form which is different for each unit and each year.

3. Theoretical Background

Today, methods of data envelopment analysis and productivity indexs have been used in abundance in evaluating performance of economic units. Shaik and Perin in their study investigated efficiency and productivity of production factors in agricultural sector of Mexico using two methods of data envelopment analysis and Malm Quist index during 1962-1997. The results suggest that total production factor productivity during this time, has enjoyed 16 percent growth. High level of scale efficiency during this time has been stated as one of the reasons of productivity growth of agricultural sector in Mexico.

✓ In another study, Sufian examined total production factor productivity in commercial banks in Malaysia during 1998-2003 using Malm Quist index. Interest income of banks from granting types of conveniences and amount of paid loans have been considered as bank deposits; and volume of types of bank deposits along with fixed assets of branches as bank inputs. Overall, results show that during this time, production factor productivity in Malaysian banks has dropped 7 percent. Negative impacts of technological variations have been among the reasons of banks productivity reduction.

✓ Pasioras and Safudeskalakis in their study examined total production factor productivity using Malm Quist index in 13 banks of Greece during 2000-2005. Volume of granted facilities, cash, invested and deposits assets have been considered as banks outputs; and number of employees and volume of fixed assets as inputs used by branches. Overall, the results indicated that total production factor productivity have increased during this period and enjoyed 7 percent growth. Positive changes in technical efficiency, technological, managerial, and scale changes have been all effective on productivity increase in the studied banks.

Regarding studies conducted on productivity inside the country:
✓ Salami and Langrodi (2003) investigated production factor productivity in the Agricultural Bank during 1987-1999 using Tern Quist-tail index. Totally, the results represent improvement in the performance of Agricultural Bank and 14.5 percent growth in production factor productivity. During this time, the index of output and input values has enjoyed about 34 and 20 percent growth, respectively.
✓ Adel Azar and Motameni (2004) measured and evaluated performance of organizations using dynamic model of productivity which is the same data envelopment analysis model considering the time factor as a decision marker unit.
✓ Nader Mehragan (2004) calculated investment productivity in Agricultural Bank using final productivity estimate method and investment productive elasticity.

- ✓ Mojaverian (2004) estimated Malm Quist productivity index for strategic products during 1991-2000.
- ✓ In another study Abasian and Mehregan (2006) examined total production factor productivity in various economic sectors in Iran during 1967-2001 using Malm Quist productivity index. The results of this study indicated slow trend of increase in total production factor productivity in various economic sectors. Positive factor productivity in agricultural and construction sectors and loss of factor productivity in sectors such as services and transport are other results obtained in this study.
- ✓ Alirezaei et al. (2006) evaluated productivity growth in the industry of 17 Asian countries during 1990-1999 using Malm Quist index. Falahi et al. (2006) evaluated efficiency and productivity of power companies using Malm Quist method and DEA model.
- ✓ Daneshian (2006) compared performance of universities using DEM model and Malm Quist index.
- ✓ Gholizadeh et al. (2006) studied production factor productivity in economy sectors of Iran in 1997-2003 (with emphasis on agriculture sector and the role of capital) using Malm Quist index.
- ✓ Lotfali Pour et al. (2007) evaluated technical efficiency and productivity trend of Iran's industries using Malm Quist index and DEA model.
- ✓ Sadr and Salami (2007) measured productivity of Agricultural Bank during 1993-2002 using tren Quist-tail indexs. The result of this study suggests that value index of outputs has had 37.2% growth and value index of all inputs 19% growth yearly in the studied period; that as a result of faster growth of value index of all outputs than inputs, total factor productivity index in this bank has had 15.2% growth.
- ✓ Alirezaei et al. (2007) calculated total factor productivity using Malm Quist index and examined technical and technological efficiency changes using generalized data envelopment analysis model (case study in the oil fields).
- ✓ Ahmadi (2008) in his study investigated efficiency and productivity of 40 branches of Saderat Bank in Tehran province during 2001-2005 using data envelopment analysis method and Malm Quist index. In this study, it has been revealed that in the studied sample, average level of efficiency is about 78% and changes in production factor productivity have not had a specified trend, but technical and technological changes of branches in Tehran city are in better situation than other branches in the province.
- ✓ Kashani Poor and Ghazi zadeh (2009) identified variables and effective ratios in measuring efficiency of Sepah Bank branches using Delphi method, and result of two stages survey showed that among 26 variables, 18 variables are important for measuring efficiency of branches, and the survey about 13 ratios of the bank for measuring efficiency of branches also showed that 4 ratios are important that importance coefficient of each of these 4 ratios was obtained using AHP method.
- ✓ Hejazi et al. (2009) using Camelsbem ranking model (version based on auxiliary variables) analyzed total productivity of Export Development Bank of Iran, and using Malm Quist index measured productivity growth of its branches using data envelopment analysis during 2004-2006, that results showed that productivity of Bank branches has had an average of one percent growth in 2005 and 2 percent growth in 2006.

✓ Zara Nejad and Haji Abad (2010) evaluated production factor productivity of 40 branches of Maskan Bank in Khoozestan province using Malm Quist index and data envelopment analysis method during 2006-2009. The results indicated that total production factor productivity during the studied period has had an average of 6 percent growth that technological changes are important reasons of the growth, and average of technical efficiency of branches with input-centered orientation with assumption of variable return to the scale has been 88%, 77%, 83% and 78%, respectively.

✓ Mehr Ara and Ahmad Zadeh (2010) in their study investigated role of total production factor productivity in production growth of major economy sectors of Iran; and evaluated growth share of total production factor productivity, and growth of labor and investment productive inputs in production growth of major economy sectors namely agriculture, industry and mine services sector and total of non-oil economy during 1967-2005 and indicated that average of TFP growth share in production growth of non-oil economy sector during first, second and third economic development plan has been 12.2%, 39.5% and 24.8% respectively and for the fourth development plan, it was predicted to improve up to 32.6%.

This study investigated the efficiency of bank branches in North Khorasan province in the years 2009-2011 is trying to clear analysis of the performance of bank branches offer. The survey results can be bank managers for future action to be effective resource allocation.

The basic objectives of this study include:

1.Determine the technical performance of each of the separate branches of Prosperity Bank.

2.Measuring and determining the rate of productivity growth in bank branches in North Khorasan province using indicator Kvyyst Malm.

4. Hypotheses

Technical efficiency and productivity for branch bank in North Khorasan province, we following hypothesis is tested:
1.Technical Efficiency, in each of the bank branches in North Khorasan What is welfare?
2.The efficiency of bank branches in North Khorasan province is located at what level?

5. Research Methodology

Data envelopment analysis is a linear programming method for evaluating performance of economic firms; and after a series of optimization determines that whether the intended decision maker unit is on the efficiency line or out of it. Thus, efficient and inefficient units are separated from each other; the obtained efficiency is relative and not absolute. In this analysis method, firms that have the highest ratio of output to input constitute the efficiency border.

Although the number of data envelopment analysis (DEA) models is growing day by day, the basis of all models is a few main models designed by its founders. These models are: 1. CCR model, 2. BCC model, 3. CCR-BCC model, 4.BCC-CCR model. In this study, the two CCR and BCC models are explained.

Charns, Cooper and Rhodes (1987) presented their CCR model based on minimizing production factors and assuming constant yield to CRS scale.

Charns, Cooper and Rhodes detected the problem in determining a common set of weights from outputs and inputs for evaluating efficiency of a unit. They suggested that each unit should select weights that are able to; i.e. for each decision making unit, we have an index of the ratio of all outputs to inputs; for example $\frac{u'y_i}{v'x_i}$ the u is a M×1 vector of output weights and v is a K×1 vector of input weights. To select optimal weights we have to specify the mathematical programming problem:

$$\max_{u,v}(u'y_i/v'x_i)$$
$$\text{s.t: } u'y_j/v'x_j \leq 1 , \qquad j = 1,2,\ldots,N$$
$$u , v \geq 0$$

In this case u and v values are obtained so that efficiency index of i-th decision making unit is maximum. However, given this restriction that efficiency indexs must be less than or equal to one. The problem of this almost specified formula is that it has infinite answers. To avoid this problem v́ x_i =1 restriction can be entered into the model:

$$\max_{\mu,v}(\mu'y_i)$$
$$\text{s.t} : v'x_i = 1$$
$$\mu'y_i - ux_i \leq 0 \quad , \qquad j=1,2,\ldots,N$$
$$\mu , u \geq 0$$

υ and μ are used instead of u and v due to linear transformation. This form is known as multiple form of linear programming problem. An equivalent envelopment for can be obtained for this problem using dual transformation in linear programming:

$$\max_{\theta,\lambda} \quad \theta$$
$$\text{s.t} : \quad -y_i + y\lambda \geq 0$$
$$\theta x_i - x\lambda \geq 0$$
$$\lambda \geq 0$$

λ is a N×1 vector of fixed numbers which shows weights of Reference set 1. Scalar values for θ are technical efficiency of the i-th firm that provides θ≥1 condition. This envelopment form contains less restrictions than multiple form (N+1>K+M). it should be noted that linear programming problem should be solved N times for each decision making unit (DMU).

In 1984, considering the assumption of variable yield to the VRS Scale by Banker, Charnz and Cooper, measuring efficiency with DEA method was evolved.

In this model, envelopment form is such that it does not necessarily pass through the origin. As a result, points in the project for inefficient units as convex combination of inefficient units determined to the linear combination in constant yield mode are more than the scale in the envelopment form. Thus, linear programming problem in the Kerr model can be easily used for calculating efficiency in BCC.

Only by adding the convexity constraint, the following linear programming model can be reached:

$$\min_{\theta,\lambda} \quad \theta$$
$$\text{s.t:} \quad -Y_i + Y\lambda \geq 0$$
$$\theta X_i - X\lambda \geq 0$$
$$NI'\lambda = 1$$
$$\lambda \geq 0$$

The previous model with variable returns to scale constraint does not specify that whether the firm runs on the ascending or descending returns area of scale or not. This is done by comparing non-ascending returns constraint to the scale, i.e. $NI'\lambda \leq 1$

$$\min_{\theta,\lambda} \quad \theta$$
$$\text{s.t:} \quad -Y_i + Y\lambda \geq 0$$
$$\theta X_i - X\lambda \geq 0$$
$$NI'\lambda \leq 1$$
$$\lambda \geq 0$$

In other words, the nature of return type in scale inefficiency for a particular firm is determined by comparing technical efficiency value in non-ascending return to scale state. Such that if these two are equal, then the intended firm will be faced with descending return to scale; otherwise, the condition of ascending return to scale is established.

6-Testing of Hypotheses

First hypothesis: technical performance, in each of the Bank of North Khorasan What is welfare?

Technical efficiency, in each of the branches in 89-87 years, in both fixed and variable returns to scale is described in the following table:

Table (1): Branches of technical efficiency scores for the years 2009-2011 in the case of constant returns to scale

2011	2010	2009	Name of Branch
1	1	1	Markazi Bojnourd
1	0.695	1	Samen Bojnourd
0.876	0.763	0.845	17shahrivar Bojnourd
1	0.885	1	Shahid Bojnourd
0.806	1	0.534	Esfaraien
0.607	0.678	0.836	Shirvan
0.845	0.751	0.871	Ashkhaneh
1	1	0.680	Farooj
0.686	0.616	0.890	Jajarm

Table (2): Branches of technical efficiency scores for the years 2009-2011 in the case of variable returns to scale

2011	2010	2009	Name of Branch
1	1	1	Markazi Bojnourd
1	0.801	1	Samen Bojnourd
0.880	0.857	1	17shahrivar Bojnourd
1	1	1	Shahid Bojnourd
0.893	1	0.900	Esfaraien
0.656	0.699	0.840	Shirvan
0.854	0.843	0.883	Ashkhaneh
1	1	1	Farooj
1	1	1	Jajarm

7. Findings

7.1 Variables Used For Research

In the DEA two variables are required:

Input variables (inputs) and output variables (output)

Intermediate input variables based on attitude, deposits and staff will be considered**.**

Output and profits are used by the facility.

7.2 Results Analysis

Statistical population of the study consists of nine branches of Refah Bank in North Khorasan province. Period and time of study is a 3-year period from the beginning of 2009 until the end of 2011. Given the importance of the research and following the mediator attitude (in this attitude, banks are considered as a financial services intermediary institution. From Carl and Davis viewpoint (1992), banks act as providers of intermediary services through collecting deposits and other debts and converting them into interest-bearing assets such as: types of loans, securities, and other investments, inputs and outputs of branches were defined given the impact and importance of each of affecting factors on branches performance, and finally deposits and personnel were considered as inputs. Output selected for this study is facilities and profits; and facilities are in the form of exchange contracts, including contracts of: installment sales, co-partnership, civic participation, dealing in futures and lease-option.

7.3 Evaluation Of Technical Efficiency Of Branches

After collecting the required information, the efficiency of Refah Bank branches has been calculated in each of the years 2009-2011. Overall, results of evaluation technical efficiency with input-centered orientation indicate that average of efficiency scores of the studied branches in a constant return to scale state has been 0.851, 0.253 and 0.844 respectively. In other words, given the current level of branches outputs in each of the studied years, there is the possibility of 0.149, 0.747 and 0.156 reduction in inputs level used in the branches. Technical efficiency average of various branches during the studied years is 0.851, 0.821 and 0.869 respectively.

7.4 Evaluating The Changes In Total Productivity Of Production Factors Using Malm Quist Index

During the study period from 2009-2011, year 2009 is studied as the base year.
In table 1, productivity indexs in Refah Bank branches in North Khorasan province are studied.

Table1. Productivity indexs of the bank branches during 2010

Changes in production factor productivity (TEPCH)	Changes in scale efficiency (SECH)	Changes in pure technical efficiency (PECH)	Changes in technical progress (TCH)	Changes in technical efficiency (EFCH)	Branch name
0.83	1	1	0.83	1	Markazi Bojnourd
1.04	0.86	0.80	1.51	0.69	Samen Bojnourd
0.93	1.05	0.85	1.03	0.90	17shahrivar Bojnourd
0.77	0.88	1	0.87	0.88	Shahid Bojnourd
2.18	1.68	1.11	1.16	0.87	Esfaraien
1	0.97	0.83	1.23	0.81	Shirvan
1.15	0.90	0.95	1.34	0.86	Ashkhaneh
4.79	1.47	1	3.26	1.47	Farooj
1	0.69	1	1.45	0.69	Jajarm

Source: researcher's findings

Studying the indexs shows that Farooj branch has had scores higher than unit in all indexs, and next Esfarayen branch with high scores in 4 evaluation indexs; and central Bojnoord and Jajarm each with 3 high indexs than the rest of the branches are located in second and third rows. In table 2, top branches and also branches with unfavorable conditions in 2010 are ranked and the scores of their indexs are listed.

Table 2. Studying scores of indexs in branches with favorable and unfavorable conditions during 2010

Index size	Name of the branch with unfavorable condition	Index size	Name of top branch	Index name
0.69	Samen bojnourd & Jajarm	1.47	Farooj	(EFCH) Changes in technical efficiency
0.83	Markazi Bojnourd	3.26	Farooj	Changes in technical progress (TCH)

0.80	Samen Bojnourd	1.11	Esfaraien	Changes in pure technical efficiency (PECH)
0.86	Samen Bojnourd	1.68	Esfaraien	Changes in scale efficiency (SECH)
0.77	Shahid Bojnourd	4.79	Farooj	Changes in production factor productivity (TEPCH)

Source: researcher's findings

In table 3, productivity indexs of Refah Bank branches are studied during 2011.

Table 3. Productivity indexs of the bank branches during 2011

Changes in production factor productivity (TEPCH)	Changes in scale efficiency (SECH)	Changes in pure technical efficiency (PECH)	Changes in technical progress (TCH)	Changes in technical efficiency (EFCH)	Branch name
0.54	1	1	0.54	1	Markazi Bojnourd
1.04	1.15	1.24	0.72	1.43	Samen Bojnourd
0.80	1.11	1.02	0.69	1.14	17shahrivar Bojnourd
0.62	1.12	1	0.55	1.12	Shahid Bojnourd
0.64	0.90	0.89	0.79	0.80	Esfaraien
0.85	0.95	0.93	0.95	0.89	Shirvan
0.90	1.11	1.01	0.80	1.12	Ashkhaneh
0.35	1	1	0.35	1	Farooj
1.25	1.11	1	1.12	1.11	Jajarm

Source: researcher's findings

Studying indexs shows that Jajarm branch has had score higher than unit in all indexs, and next Samen of Bojnoord branch with 4 high evaluation indexs, central and 17th Shahrivar of Bojnoord, Esfarayen, Ashkhaneh and Farooj each with having 3 high indexs than the rest of the branches are located in the third row of this evaluation.

In table 4 top branches and also branches with unfavorable conditions in 2011 are ranked and scores of their indexs are listed.

Table 4. Studying scores of indexs with favorable and unfavorable conditions during 2011

Index size	Name of the branch with unfavorable condition	Index size	Name of top branch	Index name
0.80	Esfaraien	1.43	Samen Bojnourd	Changes in technical efficiency (EFCH)
0.35	Farooj	1.12	Jajarm	Changes in technical progress (TCH)
0.89	Esfaraien	1.24	Samen Bojnourd	Changes in pure technical efficiency (PECH)
0.90	Esfaraien	1.15	Samen Bojnourd	Changes in scale efficiency (SECH)
0.35	Farooj	1.25	Jajarm	Changes in production factor productivity (TEPCH)

Source: researcher's findings

Studying annual average of Malm Quist index than the base year (2009) in table 5 shows that total productivity of production factor during 2009-2011 has enjoyed an average of 1 percent growth. In this regard, total productivity of production factor after a 25-percent growth in 2010 has had a 23-percent drop in the next year.

Technical efficiency in 2010 has had a descending trend with a 4-percent drop while this index has had a 6-percent growth in 2011.

Branches management efficiency show 3 percent drop in the annual average.

Technological changes in 2010 have had 29 percent growth than the base year.

Branches scale efficiency shows ascending trend with 3 percent growth.

Table 5. Annual average of Malm Quist productivity index during 2009-2011

Changes in production factor productivity (TEPCH)	Changes in scale efficiency (SECH)	Changes in pure technical efficiency (PECH)	Changes in technical progress (TCH)	Changes in technical efficiency (EFCH)	year
1.25	1.02	0.94	1.29	0.96	2010
0.73	1.05	1.01	0.69	1.06	2011
0.96	1.03	0.97	0.94	1.01	average

Source: researcher's findings

Also in table 5, annual average of Malm Quist productivity index has been presented for each of the studied branches separately.

For example, in this table, branch 2 which is Samen of Bojnoord branch has had 4 percent growth average in technological efficiency; and since it has experienced average one in the other efficiency changes of technical, pure technical and scale, so generally, total productivity of production factor in this branch based on Malm Quist index has enjoyed an average of 4 percent.

Based on Malm Quist index, during this time, branches 8 and 1 with 30 and 50 percent productivity changes respectively have the most growth rate average and productivity drop during 2009-2011.

Studying changes trend of factor affecting changes trend of production factor productivity in Refah Bank indicates that branch 5 with 22 percent growth and branch 6 with 15 percent drop have had the most and least changes in technical efficiency of branches respectively.

In terms of technological changes, branches 9 and 1 with 27 percent and 33 percent have experienced the most growth and drop respectively.

In terms of pure technical efficiency, branches 8, 4, 2, 1 and 9 with an average of one have had the highest average among other branches, and branch 3 with an average of 7 percent has had the lowest drop.

In terms of scale changes, branch 5 with 23 percent growth average has had the most growth and branch 9 with 13 percent drop has had the most drop during the studied years.

Table 6. Average of Malm Quist index divided to branches during 2009-2011

Changes in production factor productivity (TEPCH)	Changes in scale efficiency (SECH)	Changes in pure technical efficiency (PECH)	Changes in technical progress (TCH)	Changes in technical efficiency)EFCH(	Branch
0.67	1	1	0.67	1	1
1.04	1	1	1.04	1	2
0.86	1.08	0.93	0.85	1.01	3
0.69	1	1	0.69	1	4
1.18	1.23	0.99	0.96	1.22	5
1.02	1	0.98	1.08	0.85	6
1.02	1	0.98	1.03	0.98	7
1.30	1.21	1	1.07	1.21	8
1.12	0.87	1	1.27	0.87	9

Source: researcher's findings

Graphical review of technical efficiency changes, technological changes and also total productivity changes of production factor in the above table are as follows:

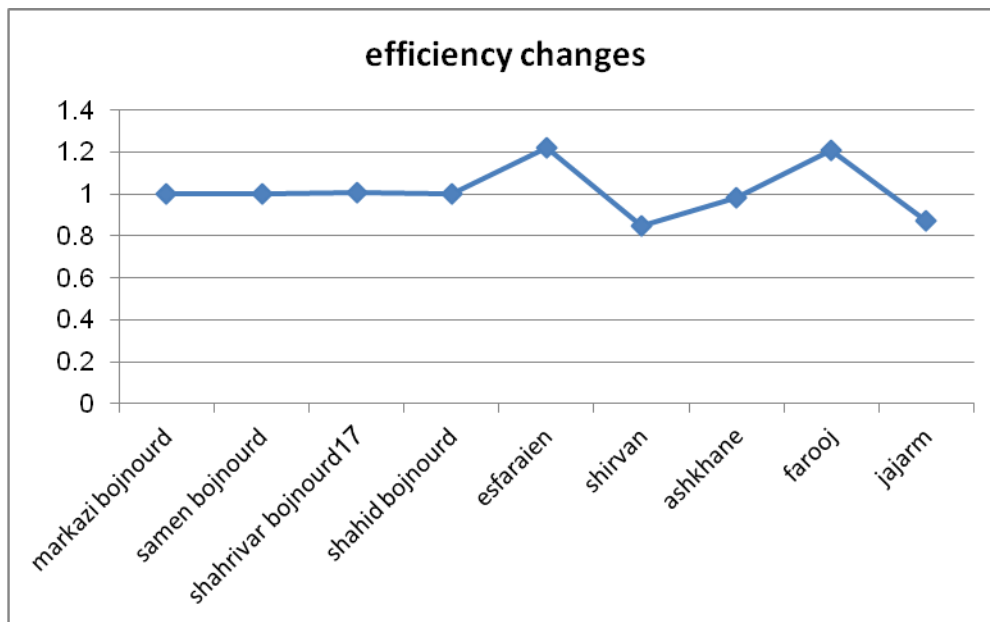Diagram 1. Average of efficiency changes during 2009-2011

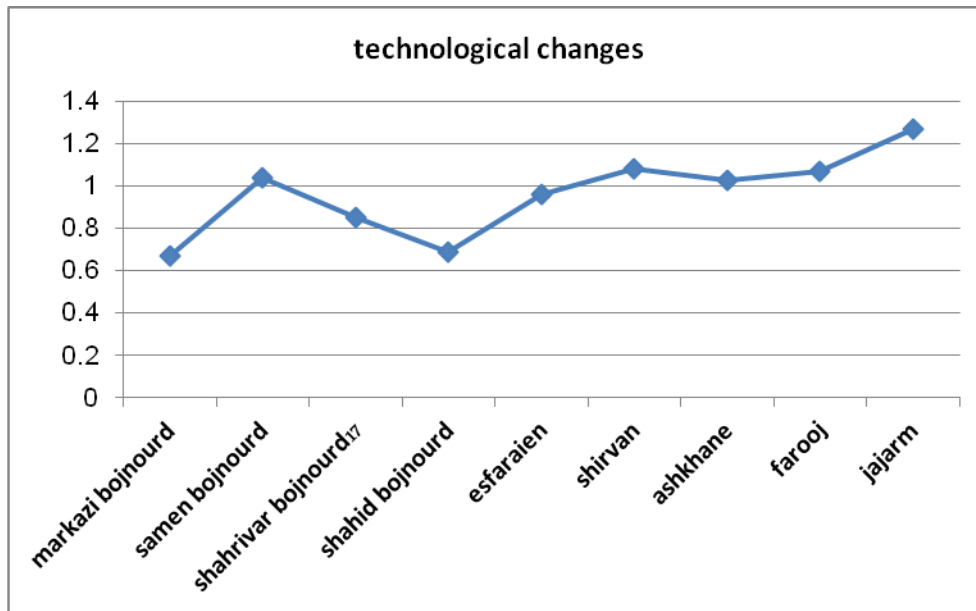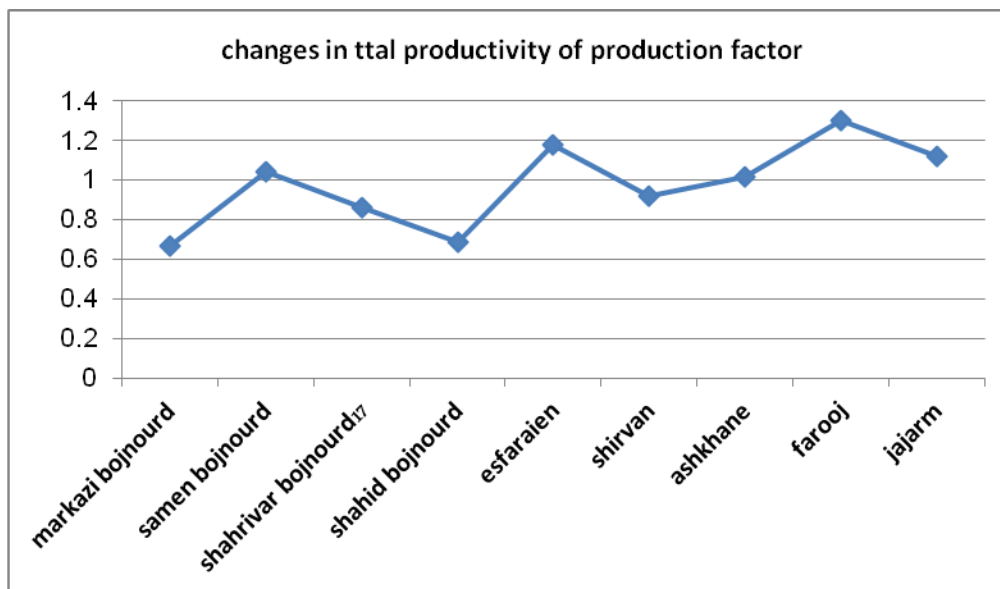Diagram 2. Average of technological changes during 2009-2011

Diagram 3. Average of total productivity of production factor during 2009-2011

8. Research Results

This study has examined total productivity changes of production factors in Refah Bank branches of the province during 2009-2011 using Malm Quist index. Among the study results are detecting changes trend of production factor productivity and role of each of technical and managerial factors in these changes and how to reach optimum productivity level.

Annual average of Malm Quist productivity index than 2009 indicates that average total production factor productivity during the studied period has had 1 percent growth. All branches

had positive technological changes and this has caused that production factor productivity of Refah Bank branches increases.

Given the nature of the model (input-oriented) and assuming that management of branches has the ability to control the used inputs; hence, inefficient branches should save in the use of their inputs to a certain amount to achieve technical and scale efficiency.

In this case, scores changes trend of efficiency and Malm Quist productivity indexs require that additional peripheral studies be conducted about the reasons of these changes.

9. Suggestions

The present study has investigated the position of technical efficiency and also production factor productivity of Refah Bank branches in North Khorasan province. Peripheral studies such as examining efficiency of banking services quality, and profitable efficiency can evaluate performance of branches from other aspects that are all complementary besides measuring efficiency of production and cost of branches. Also it is recommended that SFA method and Tern Quist index be also used in next studies, because that way, other dimensions of their efficiency and productivity will be specified.

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