The Evaluation of Productivity Growth in one of the Branch Bank by Using DEA Method and Tornqvist Index

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Abstract: Productivity is access to resource optimal allocation and facilities in order to fulfill maximum production rate. Total factor productivity is a criterion for evaluation productivity rate at organization. According to fourth plan of development, total economic sectors of country is required that part of GDP growth in the country that provide it in during the fourth plan of development , that is from place of total factor productivity of production. So based on, contribution to total factor productivity growth of services that financial institutions is it's appendix, the growth of production sectors and GDP prognosticate 21.9 per cent and of this rate is considered the process of annual growth of work force productivity, capital and total factor in order 6.5, 1.6, 2 per cent. The methods for calculating productivity are divided to two main sections such as parametric or nonparametric. In this research, by use of DEA that is an nonparametric method, At first, productivity (technical efficiency) the branch of Boroujerd Refah Karegaran Bank has been calculated during 20 years and so, with the efficiency of this model that is achieved by combination DEA and Tornqvist index, total factor productivity growth in this branch during 20 years has been calculated. The overall results suggest that productivity of production factors in this branch, the average annual growth is equal to 1.0019 per cent, is faced that is far from objective contained in fourth plan of development (2 per cent).

Highlight

► Total factor productivity is a criterion for accounting productivity rate in organization. This index indicates the process of changing total cost to total income. ► Data envelopment analysis (DEA) is a tool for evaluation and measuring the efficiency of a set of decision making units that consume multiple inputs and produce multiple outputs. ► Tornqvist index is a useful tool for calculating total factor productivity growth during the period, and by using extension of inputs and outputs in DEA address to calculate productivity growth.

Key Words

- Total Factor Productivity;
- DEA;
- Tornqvist Index

1. Introduction

In modern word, promotion of productivity is considered one of the national priorities of each country, because economic survival and improve the lives of people depends on productivity promotion. Productivity growth of society will be caused enhanced GDP and since GDP divide on population is explanatory of per capita income, so improve productivity led to increase divided wealth among population. To increase per capita income will be caused development lives and improvement of people to access more goods and services with high quality.

In various companies and organizations, profitability is an indicator of present financial position and productivity is explanatory of its future position. Therefore, an organization or company when can be hopeful to self-sustained profitability that attend to productivity subject; as increase productivity in long--term will caused to decrease cost and increase profitability rates. But, productivity improvement of an organization, in addition cases that listed caused to improve performance of various parts, development and improvement in competitive market. Also, management of that organization can define best ways for optimal and suitable resources allocation, and making decision increase profit organization. In discussion of country, productivity increase led to increase economic competitive, increase per capita income, reduce cost, increase profitability, optimal use of resources and increase GDP and etc. So development of each society depends on its productivity.

Total factor productivity is a criterion for accounting productivity rate in organization. This index indicate the process of changing total cost to total income, so it's increase in organization can led to development of competitive market, improvements of various parts performance, move dose to planned purposes decline costs, increase incomes, service and product quality improvement. So this paper indicate necessity more attention to access best and factor statistic of productivity growth.

Fourth program of development states that all executive obliged to define productivity promotion share in related production growth, and necessary requirements and solution for success, there for country evaluation from institution based to economic
efficient; So that productivity share of total factor in GDP attained 31.3 and average annual growth of work force productivity capital and total factor of production to minimize value order to 3.5%, 1%, 2.5%.

So, the necessity of productivity growth of total factors and effective factors is characterized by attention to this law and listed reasons. For achieving to listed purposes in one organization, First productivity rate of an organization should be accounted in past periods and then to identity factors influencing on productivity growth proceed to programming and presentation solutions in order to enhance productivity and success listed values in mentioned law.

Investigation of productivity changing process, First time at 1957 was proposed by famous research of Robert Solow. Solow investigated the technology effect and technical knowledge in productivity growth in study of united state productivity growth.

At 1982, Nishimizu & Page analyzed productivity growth in to factors such as changing in efficiency and technology change.


Xiayan and Contributors (2007) presented one model of prediction of bankruptcy for Chinese active companies in stock by using of DEA.

Alirezaiee and Contributors (2007) have been calculated in the study by combination of DEA and Tornqvist productivity growth, in addition calculation of TFP growth, effects of technical efficiency change and technology changes in related growth during the time, however DMU. Case study of this research is in Electricity industry that has been investigated TFP growth and effective factors in its growth during 1968-2004.

Javad Rezaee and Contributors (2009) have been evaluated TFP changes in Tehran stock by using Tornqvist index.

Methods of calculating productivity of production factors divide to 2 main categories, such as parametric or nonparametric methods.

In this paper, it is an attempt to evaluate and calculate of productivity growth one branch of Refah Bank by linear planned methods that is nonparametric methods. This method is combination of DEA and Tornqvist index as well growth calculation TFP during 1992-2011, has been calculated the impact of performance and technology change in related growth during 20 years and however with DMU.

It is an attempt to this research calculates productivity growth in one branch of Boroujerd Refah Bank during 20 years; to determine what is the branch performance each year and the process of index productivity growth has been in order to fulfill fourth plan goals?

2. Definition and concepts

Definition 1- Efficiency: The actual efficiency ratio to standard efficiency and determined is expected, in fact real output ratio to expected output.

Definition 2- Technical Efficiency is the ability of one unites to access maximum output per set of fixed input. In other words, technical efficiency is difference between output ratios to observed input with ratio between outputs to input in the best production condition.

Definition 3- Allocation Efficiency is the ability one unit in using of input ratios for production by attention to price and technology, so that minimizes production costs.

Definition 4- Productivity: Productivity is the combination of effectiveness and efficiency because effectiveness is related to performance and efficiency by using of resources.

Generally, concepts of productivity state relation between produced goods and services quantity and used resources quantity in production process of this goods and services that this relation is quantities and measurable.

Definition 5- Total income and total cost: It is considered that Decision Making Unit $p$ include inputs are $X = (x_1, x_2, ..., x_n)$ and outputs are $Y = (y_1, y_2, ..., y_m)$, if the prices of inputs and outputs are order $R = (r_1, r_2, ..., r_n)$, $Q = (q_1, q_2, ..., q_m)$, then total income and total cost is defined as follow:
Definition 6- Total factor productivity: The ratio total income to total cost in Decision Making Unit is called total factor productivity. Therefore with pervious definition, we have:

\[ TFP = \frac{\sum_{j=1}^{m} q_j y_j}{\sum_{i=1}^{n} r_i x_i} \]  
Eq. (B.1)

So, total factor productivity is an indicative conversion rate of total cost to total income.

\[ \sum_{j=1}^{m} q_j y_j = TFP \times \sum_{i=1}^{n} r_i x_i \Rightarrow TR = TFP \times TC \]  
Eq. (B.2)

Definition 7- Elasticity of input in one output

Relative change of one output per 1 in one input is called elasticity of input in output. There for we have:

\[ E_{ji} = \frac{\delta Y_i}{\delta X_j} \times \frac{X_j}{Y_i} \]  
Eq. (C)

In that \( E_{ji} \) is input elasticity value \( j \) th \( (x_j) \), in output \( i \) th \( (y_i) \).

3. TFP calculation with DEA models

Whit attention to definition 6 in second sections, total factor productivity is attained of total income ratio to total cost. But for calculation of total income and total cost, are required weights in order to aggregation inputs and outputs. Therefore, in parametric methods for calculating TFP of function that used to determine relation between inputs and outputs. Before using this function, its parameters are estimated by a regression equation. As result parametric behaviors of parameters mean used in order to calculate weights and finally TFP.

But TFP in nonparametric DEA calculate regards to individual observations of Decision Making Unit and optimal contrast with other units. In this method, without use functional form and by using of mathematical planning, the border is established that is indication maximum productivity value for per unit respect to observed productivity of other units, then for TFP calculation, is not required predetermination, production function and as determination fix weight, but in this method and in competitive space address to determine optimal weights in order to calculate total income and total cost.

To be more precise, DEA models by creation of competitive space-that creates by productivity of units under searching-that allocates weights to per unit specially. In these methods, calculated TFP by these models, a comparison can be found.

So, not only attained TFP value is statement of change rate total income to total cost, but also comparative capabilities can be useful occurred to rating of Decision Making Unit based on higher productivity.

We considered, there is \( n \) Decision Making Unit that every one included input \( m \) and output \( s \), so matrix \( m \times n \) indicate inputs by \( X \) and matrix \( s \times n \) indicate output by \( Y \). In addition, \( x_j \), \( y_j \) indicate order input and output vector of \( j \) th unit. So, the model of TFP calculation with output oriented property (output oriented CCR model) consists of:

\[ \text{Max } Z_k = \sum_{r=1}^{s} u_r y_{rk} \]  
Eq. (D.1)
Presented model for DMU_p that p = 1, 2, ..., n once equal is TFP value of p th. So that units consist of best possible efficiency and productivity that TFP value is equal to 1. Otherwise, considered unit is inefficiency, and it doesn't have optimal productivity and inefficiency rate is equal to TFP value that is derived by target function.

Productivity measurement in technical efficiency format can be divided to effectiveness and efficiency. DEA more is attention to technical efficiency in Productivity measurement.

4. Total factor productivity growth

Traditionally researches returned to Solow studies in special productivity growth. Solow investigates the effect of technology and technical knowledge in study of united state productivity growth.

At 1982, Nishimizu & Page analyzed productivity growth in to factors such as changing in efficiency and technology change. With regard to the objections raised in the parametric methods, scientists began using nonparametric methods.

4.1 Malmquist Index

Caves, Christensen & Diewert (1982) defined Malmquist index of productivity by attention to distance-production factors function as follow, so that E_t^{t+1} technical efficiency change and T_t^{t+1} technology change evaualmente in border transfer between two period's t and t+1.

\[
M_{t+1}^{t}(y^{t+1}, x^{t+1}, y^t, x^t) = \left[ \frac{D_t^{t+1}(y^t, x^t) D_t^{t+1}(y^{t+1}, x^{t+1})}{D_0^{t+1}(y^{t+1}, x^{t+1}) D_0^{t+1}(y^t, x^t)} \right]^{1/2}
\]

\[
= \left[ \frac{D_t^{t+1}(y^t, x^t) D_t^{t+1}(y^{t+1}, x^{t+1})}{D_0^{t+1}(y^{t+1}, x^{t+1}) D_0^{t+1}(y^t, x^t)} \right]^{1/2} = E_t^{t+1} \times T_t^{t+1}
\]

\[
= \left[ \frac{D_0^{t+1}(y^t, x^t)}{D_0^{t+1}(y^{t+1}, x^{t+1})} \right] \times \left[ \frac{D_t^{t+1}(y^{t+1}, x^{t+1}) D_t^{t+1}(y^{t+1}, x^{t+1})}{D_t^{t+1}(y^t, x^t) D_t^{t+1}(y^{t+1}, x^{t+1})} \right]^{1/2}
\]

With attention to above relation if there are productivity growth, this index will be greater than unit and if there are not productivity growth is smaller than unit. Also, it don't observe any change in outputs and inputs, it means that x^t = x^t+1, y^t = y^t + 1, this index is equal to unit. Distance function value attained based on investigation unit position under study in period q = \{t, t+1\}, D = (x^q, y^q) of border function (combination credits- inputs in period p, p = \{t, t+1\}, D = (x, y) ), data of units value data are used that are based on follow models:

\[
(D_{0}^{t+1}(X_{t+1}, Y_{t+1}))^{-1} = max \emptyset
\]

\[
s.t.: \quad 0Y_{it+1} + Y_{t+1} \lambda \geq 0 \quad \text{Eq. (F.2)}
\]

\[
X_{it+1} - X_{t+1} \lambda \geq 0 \quad \lambda \geq 0 \quad \text{Eq. (F.3)}
\]

\[
(D_{0}^{t}(X_{t}, Y_{t}))^{-1} = max \emptyset \quad \text{Eq. (F.4)}
\]
\[
\begin{align*}
\text{s.t.:} & \quad -\vartheta Y_{it} + Y_i, \lambda \geq 0 \quad \text{Eq. (F.5)} \\
& \quad X_{it} - X_i, \lambda \geq 0, \lambda \geq 0 \quad \text{Eq. (F.6)} \\
& \quad \{D_0^{t+1} (X_t, Y_t)\}^{-1} = \max \varnothing \quad \text{Eq. (F.7)} \\
\text{s.t.:} & \quad -\vartheta Y_{it} + Y_{t+1}, \lambda \geq 0 \quad \text{Eq. (F.8)} \\
& \quad X_{it} - X_{t+1}, \lambda \geq 0, \lambda \geq 0 \quad \text{Eq. (F.9)} \\
& \quad \{D_0^{t+1} (X_{t+1}, Y_{t+1})\}^{-1} = \max \varnothing \quad \text{Eq. (F.10)} \\
\text{s.t.:} & \quad -\vartheta Y_{it+1} + Y_t, \lambda \geq 0 \quad \text{Eq. (F.11)} \\
& \quad X_{it+1} - X_t, \lambda \geq 0, \lambda \geq 0 \quad \text{Eq. (F.12)} \\
\end{align*}
\]

Fare, Grosskopf, Lindgen & Roos (1989) address, to discussion of inefficiency in productivity Malmquist index that in distance function conditions has value smaller than 1.

Malmquist productivity index is separated to 2 indexes:

1. Measurement of efficiency changes \( EC \) 
2. Measurement of technology changes \( TC \)

Technology changes size indicate as credit and input curves changes.

\[
M_0(Y^{t+1}, X^{t+1}, Y^t, X^t) = EC \times TC \quad \text{Eq. (G)}
\]

In analyzes of productivity measurement, discussion about output to scale is addressed. However, with attention to separate efficiency to two categories such as efficiency (managerial efficiency) and scale efficiency, can investigate thrift ratio to scale.

Technology efficiency changes * Scale efficiency changes * managerial efficiency changes = Total productivity changes of production factor

Management efficiency is considered as hard work, effort and management and employees creativity and suitable combination of production factors in order to increase productivity. In situation that production average cost for industry supplier with large scale is less than production average cost for supplier with small scale, there will be saving by scale in production.

Technology efficiency is explanatory technique and technology in order to use for more production by same resources and inputs or access to pervious production rate is less used in conditions that first material and work inputs and used capital.

In DEA method and using techniques of linear planning, nonparametric method is used for calculation production function. For analyzing this method and for calculating the same production function, special presupposition in related function shape will be considered. So, distance-production is used, and then if there is condition of using \((l)\) force work resources and capital \((k)\), we have:

\[
D_p (x_q, y_q) = \max \varnothing_h \quad \text{Eq. (H.1)}
\]

\[
\text{s.t.:} \quad \varnothing_h y_{hq} - \sum_{i=1}^{n} \lambda_i y_{ip} \leq 0 \quad \text{Eq. (H.2)}
\]

\[
\sum_{i=1}^{n} \lambda_i k_{ip} \leq k_{hp} \quad \text{Eq. (H.3)}
\]

\[
\sum_{i=1}^{n} \lambda_i l_{ip} \leq l_{ip}, \lambda_1, \lambda_2, \ldots, \lambda_n \quad \text{Eq. (H.4)}
\]

\[(p, q) \in \{(t, t), (t, t + 1), (t + 1, t), (t + 1, t + 1)\} \quad \text{Eq. (H.5)}
\]
Distance function, is inverse\(\emptyset\). This method compares the combination of input or output of every Decision Making Unit in during \(q\) by border production function that include combinations input and output of every unit in during \(p\). By considering unvaried of capital \((k)\) and \((I)\), work force, production-distance function is explanatory that how much increase output Decision Making Unit \(h\) in period \(q\) up to access point on border function that is combination of all units in period \(p\). So, each unit in period \(q\) is established by one point on function that is linear combination of inputs and outputs weights of all units in \(p\) periods, is compared.

Also, above analysis is performed by consideration fix output respect to scale and in condition of variety output to scale of technique efficiency analysis results is attributed to scale efficiency and management efficiency.

\[
M_t^{q1}(y^{t1}, x^{t1}, y^{t}, x^{t}) = \frac{D_t^q(y^{t1}, x^{t1})D_t^{q1}(y^{t1}, x^{t1})}{D_t^q(y^{t}, x^{t})D_t^{q1}(y^{t}, x^{t})} \quad \text{Eq. (1.1)}
\]

\[
\left[ \frac{D_t^q(y^{t}, x^{t}) D_t^q(y^{t}, x^{t})}{D_t^{q1}(y^{t1}, x^{t1}) D_t^q(y^{t1}, x^{t1})} \right]^{1/2} = E_t^{q1} \times T_t^{q1} \quad \text{Eq. (1.2)}
\]

\[
\frac{D_t^{q1}(y^{t1}, x^{t1})}{D_t^q(y^{t}, x^{t})} \times \left[ \frac{D_t^q(y^{t1}, x^{t1}) D_t^{q1}(y^{t1}, x^{t1})}{D_t^q(y^{t}, x^{t}) D_t^{q1}(y^{t}, x^{t})} \right]^{1/2} \quad \text{Eq. (1.3)}
\]

\[
\frac{D_t^q(y^{t}, x^{t})}{D_t^{q1}(y^{t1}, x^{t1})} \times \left[ \frac{D_t^{q1}(y^{t1}, x^{t1}) D_t^q(y^{t1}, x^{t1})}{D_t^q(y^{t}, x^{t}) D_t^{q1}(y^{t}, x^{t})} \right]^{1/2} \quad \text{Eq. (1.4)}
\]

\[
TECHCH = \frac{\delta^{q+1}(y^{q+1}, x^{q+1})}{\delta^{q1}(y^{q}, x^{q})} = PECH \times SECH = EFFCH \quad \text{Eq. (1.5)}
\]

\[
\left[ \frac{D_t^q(y^{t+1}, x^{t+1}) D_t^q(y^{t}, x^{t})}{D_t^{q1}(y^{t+1}, x^{t+1}) D_t^{q1}(y^{t1}, x^{t1})} \right]^{1/2} \quad \text{Eq. (1.6)}
\]

\[
\frac{\delta_k^{q+1}(y^{q+1}, x^{q+1})}{\delta_k^q(y^{q}, x^{q})} \quad \text{Eq. (1.7)}
\]

\[
TECHCH \times EFFCH = TPFCH \quad \text{Eq. (1.8)}
\]

Calculation of Malmquist index by productivity of DEA is performed based on comparison of the number of Decision Making Unit productivity growth during 2 periods. In other words, due to the comparing nature of DEA models and for the calculation of this index at any period is required to special data include number of Decision Making Units. Therefore, in situation that there is one unit of Decision Making Unit and the purpose of productivity growth calculation is in unit along time, this index of productivity growth calculation will be disabling. In order to solve this problem, other index is used that named Tornqvist productivity index.

4-2 Tornqvist Index

This index is a useful tool for calculating total factor productivity growth during the period, and by using extension of inputs and outputs in DEA address to calculate productivity growth. As follow, we shall see that by using attainted extension by DEA models, this index for every period is calculated and, Also like Malmquist index would be divided to two factors such as efficiency changes a technology changes. It is worth nothing that the main advantage of this index is calculation of TFP growth without need to special inputs (less Decision Making Unit) and this method has ability of TFP growth calculation with one unit of Decision Making Unit.

We considered that inputs of Decision Making Unit are during \(n\) years including \(m\) inputs and \(s\) outputs. This unit at \(k\) th year (base period) has input vector \(X^k = (x_1^k, x_2^k, ..., x_m^k)\) and output vector \(y^k = (y_1^k, y_2^k, ..., y_s^k)\) and in period \(k+1\) th is order to input vector \(X^{k+1} = (x_1^{k+1}, x_2^{k+1}, ..., x_m^{k+1})\) and output vector is \(y^{k+1} = (y_1^{k+1}, y_2^{k+1}, ..., y_s^{k+1})\).
Therefore, if situation of this unit in every year, we considered as DMU and DEA model with fix output to scale and output oriented, so the value of Tornqvist input index calculate and define as follow:

$$TQ_X = \prod_{i=1}^{m} \left[ \frac{x_i^{k+1}}{x_i^{k}} \right]^{ex_i} \sum_{i=1}^{m} ex_i = 1 \quad \text{Eq. (1)}$$

In that relation $ex_i$ calculated as geometry mean of input $i$ th extension once a year $k$ th again in $k+1$ year.

$$ex_i^{k+1} = \frac{r_i^{k+1} x_i}{\sum r_i^{k+1} x_i} \quad ex_i^{k} = \frac{r_i^{k} x_i}{\sum r_i^{k} x_i} \quad \text{Eq. (2)}$$

In fact $TQ_X$ value is explanatory of input changes during two years that calculated by using of extension value of every input in total income. So, we can define and calculate Tornqvist output value index.

$$TQ_Y = \prod_{j=1}^{s} \left[ \frac{y_j^{k+1}}{y_j^{k}} \right]^{ey_j} \sum_{j=1}^{s} ey_j = 1 \quad \text{Eq. (3)}$$

In that $ey_j$ is calculated as geometry mean of output extension $j$ th at $k$ year and again at $k+1$.

$$ey_j^{k+1} = \frac{q_j^{k+1} y_j}{\sum q_j^{k+1} y_j} \quad ey_j^{k} = \frac{q_j^{k} y_j}{\sum q_j^{k} y_j} \quad \text{Eq. (4)}$$

$TQ_Y$ Value is explanatory of output change during two years that calculated by using output extension. So, total factor productivity growth is resulted as follow:

$$TFP_{g,k+1} = \frac{TQ_Y}{TQ_X} \quad \text{Total factor productivity growth} \quad \text{Eq. (5)}$$

Efficiency change calculates during $k$ and $k+1$ as follow:

$$EC_{k,k+1} = \frac{EFF_{k+1}}{EFF_k} \quad \text{Technique efficiency changes} \quad \text{Eq. (6)}$$

Numerator is efficiency at $k+1$ year and denominator at $k$ year. Technology changes are calculated of follow relation:

$$TC_{k,k+1} = \frac{TFP_{g,k+1}}{EC_{k,k+1}} \quad \text{Technology changes} \quad \text{Eq. (7)}$$

By using DEA and Tornqvist index, we can calculate total factor productivity growth one unit during contentious periods. Also the role of efficiency change and technology change in total factor productivity growth during pass period from considered formulas is measurable and calculable. The results of formulas calculation related to Tornqvist index and its analysis is explained as follow:

Be greater than 1 define index of its part technology improvement during one period (2 frequent years) and be less than 1 TC opposite.

Finally, more than 1 in Tornqvist index mean that TFP growth is in one period (2 frequent years) and less than 1 will indicate negative growth.

5. Model variables

DEA models don’t have common weighting set. So selection of inputs and outputs influence on DEA models power is difficult. Every resource that used by DMU is considered one input, and would used by DMU in order to outputs production, so outputs should include productions or services that produced by one unit and it is possible these production and services are various quantities levels.

5-1 Inputs
Inputs: input in nonparametric methods is a factor that by adding one unit to it and considering that other condition fix, decrease efficiency and productivity.

With attention to kind of research that is productivity field of bank branch, personal is clearly one key input, and measured by the number of personal, education and their experience.

Branch costs should consider as one effective input for bank (as financial institution) that personal, official and operational cost has been included.

The importance of desired branch location doesn't cover every one as place that is preventive of financial services.

5-2 Outputs

Output: in nonparametric models, output is factor that by adding one unit to it and considering that other conditions are fix, increase efficiency and productivity.

Performance and activities of inputs led to product production (or productions) or service presentation (services) that is considered as outputs that exited of system.

Resources attractive are accounted as main and key banks activities especially commercial bank. In fact resources attractive are base substructure of other activation and total affairs and services affected of this work. Since the most important mission of banking system is funds of society and their allocation is to more efficiency and producer. One fundamental criterion is in order to value bank branch performance that increases their deposits. Resources index is considered as two groups of deposit loan (current and saving) and term deposits (long term-short term), cash deposits for guarantees, residue of sold bank cheeks, temporary crediting, and unclaimed balances and administrated funds that are not used.

The purpose of uses is all facilities that banks pained to right full and legal persons based on Central Bank of the Islamic Republic of Iran. Banks facilities granted to consumers for accessing to more profit in live optimal resources allocation. The main purpose of bank system in granting facilities earn money by funding for community is required.

Presented facilities by this branch include saving granting, Mozarebe granting facilities, self and buying loan granting facilities, forge granting facilities, installment sales granting facilities. Bank services are indicative it's activities size, output index include the number of draft issued-imported. Clearing, the number of exportation guarantee code checks code between bank, the number of participation paper the number of guarantee issued, bill entry, the number of granting facilities, the number of existing account (current, saving, long-term), the number of existing granting faculties, the number of guarantees, the number of national trust cards issuance.

The profit and loss is next output indicator that its importance is clear at all organizations.

6. Results from models

Data include 3 inputs and 4 outputs. Input is explanatory order, branch personal, branch cost and its location and output is explanatory order resources attractive rate, consumptions rate, services and profits and losses. In table 1 shows that separately (normalized data × 100).
Table 1. Dates (normalized ×100) of Refah Kargaran bank branch

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of personal</th>
<th>Branch costs</th>
<th>Branch location</th>
<th>Resources attractive</th>
<th>Uses</th>
<th>Facilities</th>
<th>Profit and loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>1992</td>
<td>31.5</td>
<td>37.2</td>
<td>100</td>
<td>9.9</td>
<td>18.7</td>
<td>19.1</td>
<td>35</td>
</tr>
<tr>
<td>1993</td>
<td>37.8</td>
<td>41.1</td>
<td>100</td>
<td>11.9</td>
<td>26.2</td>
<td>27</td>
<td>45.5</td>
</tr>
<tr>
<td>1994</td>
<td>35.2</td>
<td>44.8</td>
<td>100</td>
<td>13.5</td>
<td>31.6</td>
<td>25.3</td>
<td>56.7</td>
</tr>
<tr>
<td>1995</td>
<td>43.6</td>
<td>47.5</td>
<td>100</td>
<td>19.8</td>
<td>85.6</td>
<td>31.5</td>
<td>67.1</td>
</tr>
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<td>100</td>
<td>39.3</td>
<td>76.2</td>
<td>60.3</td>
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</tr>
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<td>50.9</td>
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<td>100</td>
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<td>71.9</td>
<td>78.1</td>
<td>56.6</td>
</tr>
<tr>
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<td>82.4</td>
<td>57.1</td>
<td>100</td>
<td>62.1</td>
<td>67.3</td>
<td>67.5</td>
<td>100</td>
</tr>
<tr>
<td>1999</td>
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<td>64.2</td>
<td>100</td>
<td>84.6</td>
<td>83.6</td>
<td>100</td>
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By using DEA in output to fix scale CCR and output oriented, total factor productivity TFP of Refah bank branch during 20 years is indicated in table 2. By using of AP model, total grade of total factor productivity during 20 years is indicated in table 3.
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<th>Row</th>
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</table>

Table2. Total factor productivity of bank branch

By using of AP model, total grade of total factor productivity during 20 years is indicated in table 3.
In order to more accurate investigation, total factor productivity curve of bank branch is presented separately during 20 years.
According to the graph of this branch at, 1996, 2006, has had best performance during 20 years. The performance of this branch from primary period until 1996, had ascending trend, but after that had descending trend until 2001, efficiency has been increased. So the performance of this branch from 2002 to 2006, had ascending trend, but after that had descending trend until 2011, efficiency has been increased.

Results by using inputs and outputs of research model and by using of linear planning model for production factor productivity growth is indicated under table:
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<th>Period</th>
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<th>Technology changes</th>
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<td>1.0039</td>
<td>1.1812</td>
<td>0.8499</td>
</tr>
</tbody>
</table>

Table 4. Changes results of TFP growth, technique efficiency and technology

In order to more accurate investigation, the results of above table a graphs (2), (3), (4) is order to technique efficiency change, technology changes and total factor productivity growth of this bank branch during 19 periods.
Fig. 2. Technique efficiency changes curve of bank branch

Fig. 3. Technology changes curve of bank branch

Fig. 4. TFP growth curve

Most rates of technology changes of this branch for 80-81 is 1.4841 and it less rate in 95-96, 2005-2006 is 0.71.

So, most rates of productivity growth changes of this branch for 92-93, 2002-2003 is 1.3 and it less rate in 2001-2002 is 0.6882.

This branch in period 2002-2003, had 30% productivity growth that more 25% of it has been by efficiency growth in this period, and technology growth had less share in production growth. Negative productivity growth during 2007-2008, is caused by negative growth to efficiency that is 76%.

As result of production factor productivity index calculation in this bank is caused by efficiency changes and technology changes had less share respect to efficiency changes is TFP growth which this branch of bank had to it, so that technique efficiency growth means technology and TFP growth during research (1992-2011) is calculated order 1.0819, 0.9568, 1.0019 that indicated this bank branch in using of resources is efficient operation. So, this bank branch with all existing facilities with same input rate cannot result more output rate.

This bank branch by attention to input which to give it and output rate that is resulted by it and by attention to positive growth of TFP, this branch is accounted efficient branch.

Also, be more than 1 indicate (TC) is explanatory technology growth in period (2 frequent years) and be less 1 is oppose TC, so this bank branch is faced to improvement of technological aspect during 92-93, 96-97, 98-99, 99-2000, 2002-2003, 2006-2007, 2008-2009, 2009-2010, and other periods has had less improvement in aspect of technology.

Also, during 92-93, 93-94, 94-95, 95-96, 2000-2001, 2002-2003, 2003-2004, 2004-2005, 2005-2006, 2010-2011 has had highly rate of technique efficiency rate that is 1 and at 2001-2002 period has had more less technique efficiency changes rate that is 0.4637.

The important results of this research is value more than 1 in Tornqvist index means TFP positive growth in one period and value less than 1 will be indicative negative growth.

**Conclusion and suggestions:**

Use of linear planning methods for efficiency and productivity calculation of enter praises, led to positive results in order to present solution for their productivity improvement. In this research Tornqvist index for total factor productivity growth calculation of Boroujerd Refah Kargaran bank branch during (1992-2011) has been used.
With comparison total factors productivity of this bank branch that is 1.0019 rate and comparison by quantities purpose in forth program of improvement law that forecast growth of 2%, so there is impressive distance between performance and targeting.

So, investigation of results that is by production total factor productivity growth calculation of this bank branch indicate that this branch otherwise fluctuation during past years is accompanied with positive growth.

As greater technology changes, major productivity changes are caused during 19 periods. So should pay attention to this factor for planning, it means that if don't invested to equipment unit in this branch, so TFP growth should be attained completely by internal process changes and efficiency growth. There for with attention to results and how changes in TFP during last periods can improve productivity so reasonable and present best solution for improvement.

References


