An investigation of functional analysis of bank branches by Data Envelopment Analysis (DEA); a protocol study

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Abstract: Banks in some places utilize frontier efficiency examines to objectively consider best patterns within their organizations. Amongst the frontier efficiency analyzes distinguished in the literature, Data Envelopment Analysis (DEA) was found to be one of the topping approaching. DEA has been successfully utilized in many bank subdivision performance ratings using traditional inter-mediation, profitable and construct approaches. However, there has been little emphasis on evaluating the growth potency of individual branches and to provide Proportional amelioration recommendations.

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Introduction

Banking system in Iran's economy like other countries plays a very important role, because in addition to being the medium of fund in money market due to lack of undeveloped capital market has a pivotal role in financing medium term and long-term economic plans. Due to the necessity to improve financial standards, using more precise criteria to evaluate bank efficiency seems to be mandatory. In other hand, one the main concern of government officials in recent years has been to review the activities of the banking system and to reduce interest rates. Although this policy was adopted with the scientific reliability of a number of economic experts but many objections raised by a number of other professionals. But the reason of the objections raised by the operators and staff of the monetary sector was sharp reduction in bank profits and even bankruptcy because there is no match between interest rates and inflation rates. On the other hand proponents of this policy believe that the solution is the reducing of the cost and increasing the productivity of banking system (Sheman and et al, 1998). Hence the importance and sensitivity of any matter mentioned .Also, according to Article 5 of the fourth Development Plan which explicitly refers to national and provincial executive to increase productivity,in this study we try to assess and identify the needs in this regard and explain efficiency and productivity indictors and ratios of inputs and outputs of Cooperative Development Bank branches in Golestan province for the period 1388 to 1390. In addition to the need to perform these tasks at a national level or in other words the most appropriate form with maximum productivity ,economic globalization trend requires that the efficiency and productivity of labor and capital in the banking system will be improved.

The main problem in measuring productivity improvement is not creating the wealth alone but capacity building is also the creator of wealth and the increase of wealth and increase of wealth depends on the efficiency of the production is impacted. Since the efficiency and productivity of financial institutions such as bank in macro level is the aftermath of efficiency and productivity in all areas of individual branches all departments or otherwise manage its provincial branches of the micro-level measure productivity based approach to calculate the productivity index malmquist provincial cooperative development bank branches. In this study total productivity of cooperative development bank in Golestan province and productivity changes in bank branches in the province using data envelopment analysis model is examined. This model is based on a series of optimizations using linear programming, and data envelopment analysis is used for investigation and measurement. In this method the efficiency boundary curve is created by connecting a series of points which are determined by linear programming.

Linear programming after a series of optimizations determines whether the decision making unit is efficient or not so efficient and inefficient units are seperetated. Any effort to increase efficiency and productivity in the productivity cycle is including measurement, analysis, planning, and productivity improvement. Productivity measurement is the first and the most important step for any programming analysis and productivity improvement.

In this study at first we present some general points about measurement in banking industry. Then

we focus on the especial case of efficiency measurement in cooperative development bank in Golestan province. We used sectional data so in the initial effort the required ground for the analysis, programming and efficiency and productivity improvement will be possible. The ratio between the resources that are expected to be used to achieve the purposes and activities of the resources and the resources that are actually used is called efficiency. The ratio between the amount of output produced by the firm and using a certain amount of input is called productivity. The purpose of this study is investigating and measuring the bank technical efficiency changes in productivity over a three period in using Data Envelopment Analysis (DEA). Therefore the main issue of the present study is measuring the efficiency of Bank branches using DEA.

Literature review

Alirezaee (1382) in a study called 'designing a decision support system for a commercial bank branches' using DEA measured efficiency in 35 branches of Sadat bank in one of the areas of Tehran. The results of this study indicate that in the case of willingness for using strategies to improve performance with input nature the branches should reduce 39% of computer terminals.

And 62/8% of their rent cost. If they are willing to use strategies with output nature they should reduce 66/8 % of their resources, 310/5% of their uses and 52/8% of their services. If they use strategies with output nature the branches should increase 66/8% of their resources, 310/5% of their uses and 52/8% of their services until they achieve full efficiency.

Zangane (1391) assessed and measured technical efficiency and productivity changes of Mellat Bank in Golestan Province. He used DEA.The descriptive research method is postfacto and the research data was extracted from basic financial statements of Mellat Bank in the Province. We use following relations to calculate changes in total factor productivity and efficiency by using the following relations:

Productivity changes= changes in technical efficiency of production*technological changes

Changes in technical efficiency= management efficiency changes *scale efficiency changes *= management efficiency changes*technological changes*productivity changes.

So technical efficiency, management efficiency, scale efficiency and malom quist index of productivity for 40 selected branches of Golestan Mellat Bank in 1387-1389 was calculated by Windeap software. Input variables include number of personnel, current account deposits, saving account deposits, short term deposits and long term deposits and output variables are loans, and the number of Mellat cards the results indicates that Mellat bank branches in Golestan can be rated according to technical efficiency and Malmquist productivity index. Also, results show that 19 branches which is 65% of all branches were on the efficiency frontier and are known astotally efficient branches. The technical efficiency average is 91% and in some conditions variable efficiency is compared to scale. In other words 9% of branches used input and production factors more than the amount needed and by decreasing their costs can produce the same level of product. The results also indicate the economies from scale. The reason is that most of the branches have more efficiency than the scale. The results of the study show that most of the inefficiency in Mellat Bank of Golestan is the result of inefficiency in management not scale inefficiency.

Mehri Ebrahimi (1389)' An efficiency comparison between state banks and private banks using DEA'. Regarding to the role of banks in financial markets and as a result in economy, measuring banks efficiency, knowing efficiency type and their level of efficiency is very important. In this study an analysis of some banking characteristics in a four year period (1384-1387) especially an efficiency comparison is dealt with. The method is nonparametric DEA. The aim of the study is an assessment of efficiency in state and private banks using DEA. Another purpose is comparing the performance of state and private banks.

Amiri (1380) defined the criterion for efficiency in commercial banking system and also calculated that criterion. His purpose is finding shortcomings of previous planning in banking system using efficiency index. In this regard, three basic hypotheses in three parts are analyzed. In the first part he selected the best definition for Iranian banking system using a body of definitions for efficiency and calculated an efficiency coefficient for Saderat Bank branches in the province in 1377 and 1378. Using statistical and econometric models, he tested the first hypothesis that is the positive correlation between the banking system efficiency and it's structure. Results show the impact of inters organization factors on the calculated efficiency factors. In the second part of the research hypothesis that the positive correlation between supervision and banking system efficiency is analyzed and the second hypothesis test using a series of statistical indexes and analytical discussions, indicates inadequate monitoring and major weaknesses in regulatory bodies in banking system.

Problems the third hypothesis of the study which is the positive relationship between the executive power and efficiency of banking system is examined. The results of this part is indicative of severe impacts of exogenous factors on the banking system and it's efficiency. All three hypotheses are accepted.

Salami-Talachi article entitled 'measuring productivity in the banking units, a case study of agriculture bank of Iran' using Tornqvist Index.

Among the most important studies in the field of measurement and examination in Iranian banking industry is Nosratallah Nafar's study entitled:'technical efficiency of human resources in the banking industry using human resources frontier function and assigning it to the maximum likelihood method. This study is in data panel and includes 9 commercial banks for a ten years period (1367-1376). One of the interesting advantages of this study is combining both time series data and cross sectional data which increases the ability to measure dynamic modifications in the process of banking services and provide a more exact analysis for efficiency changes over time and between banks.

Abedi Far (1379) has estimated Iranian banking industry efficiency and has identified factors affecting that by using stochastic frontier functions. He used Tebis-Coli time-varying inefficiency (1992) model and Tebis-coli inefficiency model (1995). The data is related to facts and figures of country's ten banks for the time period 1367-1376. The results are as follow:

a. Total credit granted to the private sector in Iranian banking industry is a function of the number of employees, fixed assets, private sector's total amount of saving deposits, private sector's total amount of investment deposits, and time.
b. Specialized banks are more efficient than commercial banks.
c. Bank size is positively related to technical efficiency of banks
d. Concentration of bank branches in Tehran has a positive effect on the bank technical efficiency

A study entitled ' efficiency in Italian banking industry: DAE and neural networks ' has been conducted by Ann Rust and Anthony G.Zoarikh. The following is a summary of the study:

This article examines the efficiency of 100 big banks in Italy in the period 2000-2001. Input and output deposit is used as the nominal value (million euros) and natural logarithm of the values. Deviation of the mean is calculated between the total factor of productivity and estimated factor. Also, arithmetic average of Malmquist productivity index in addition to geometric average is calculated.

Ranking coefficient is calculated in order to identify the relationship between the bank size and the performance. The experimental results show that using natural logarithms and neural networks reduce errors in estimation. At last,

There is an inverse relationship between the size and productivity growth as compared to the literature.

Gian franco (2004) in a study based on the utility model of banking Efficiency, claimed in Bangladesh Islamic banks can remain even within the conventional banking system (a system based on interest rate) with regard to the system of profit and loss sharing (PLS) based on a discount rate of participation in profit and loss based is Advantage is much less. Sarker then argues that, Islamic products have risk characteristics and different outcomes based on precautionary contracts.

Christopher & H. Lozano (2002), studied Belgium, Denmark, France, Germany, Italy, Luxembourg, the Netherlands, Portugal, Spain and the UK banking industries. At first, researchers have tried to assess the banking industry efficiency scores which in their respective countries are dominant. The results suggest that the efficiency scores of banks outside Denmark, Spain and Portugal were relatively more successful and profitable technique. Especially when they try to enter any other European country's banks may be more useful. The banks in France and Italy among other banks were the least efficient firms. Fernandez Gascon and Gonzalez (2002) 142 economic efficiency of financial intermediaries from 18 countries during 1998 and 1989 the relationship between profitability and productivity changes and shareholder wealth in the history of the studied. The authors used the DEA profitable relative to commercial banks in different geographical regions (North America, Japan and Europe) to estimate. European banks of Austria, Belgium, Denmark, Finland, Germany, Ireland, Italy, Luxembourg, Norway, Portugal, Spain, Sweden, Switzerland and England.

Hypothesis:

Accordingly, the research questions are stated as the following:

H.1: What are the factors affecting the performance of Cooperative Development Bank?

H.2: How is the efficiency and ranking status of each branch of Bank using DEA?

Research Method

The aim of the present study is applied and the method is descriptive- analytical. Since the research data was extracted from basic financial statements of Bank and branches are compared in terms of efficiency and productivity. It should be mentioned that the method of research, type of study is library and based on articles and books related to the topic. Also, statistical data and mathematical methods are used.

Research period: The study will be conducted in 2012-2013

Research area: All branches of Bank in khorasan province in the years 2011 to 2013 will be measured.

Sample size: Sampling is not performed in this study, but all branches of Bank will be studied. Sample size is equal to total population. (N=n)

Variables:

The variables used in this study are as follows:

- Performance: Is the result (output) of the activities performed during a given time period.

- Assessment: Judgment as objective as possible, based on qualitative and quantitative measurement regarding efficiency and effectiveness during a given time period.

- Output: Including loans and current credit facilities, past due receivables and delayed receivables.

- Input: Including number of employees, current account amount, saving account amount, short term accounts and long term accounts.

- Efficiency: The ratio of the amount of productive resources or inputs to produce a given amount of goods or services to the resources or inputs that are actually used.

Weighted set of inputs / sum of weighted outputs = efficiency

If the inputs to be X1j X2j ... Xmj and Outputs to be X1j Y2j ... Ysj, then Efficiency $= \frac{u1y1 + u2y2 + \cdots}{v1x1 + v2x2 + \cdots}$ Output weight =u Weighted inputs ; =V

- Technical efficiency: Firm's ability to optimize production regarding firm's facilities for production.

- Allocative efficiency: Is the firm's ability for using optimal combination of production factors with respect to the price of production factors.

- Economic efficiency: Is the product of technical efficiency and allocative efficiency.

- Scale efficiency: It refers to the optimal choice of the size. In other words, the ratio is for measuring efficiency to scale. It means that in units that are technically inefficient by calculating this ratio we know what part of inefficiency was due to non-optimal scale.

-Management efficiency: This efficiency refers to correct and optimal methods for management.

Productivity: Is the comparison of a firm's performance during two different times or the comparison of two firms efficiency at the same time. In other word,

Productivity is the comparison of efficiency.

Index: Is a characteristic for measuring inputs, output process and performance.

Malmquist index: Is an index for measuring efficiency changes during time.

- -Data Envelopment Analysis: A Mathematical Programming (Operations Research) and provides the possibility to calculate the technical efficiency of decision making units with multiple inputs and multiple outputs without requiring them to assign weights to inputs and equalizing them.

-Fiscal period: The period for calculating annual financial status and business organizations in a variety of applications. This study examines the fiscal years of 1388, 1389 and 1390 in the population.

Data analysis:

In this study, the measurement of efficiency and productivity is performed using data envelopment analysis (DEA). DEA method is based on a series of optimizations using linear programming. In this method, the efficient frontier curve is created by linking a series of points determined by linear programming.

After a series of optimizations the linear programming method specifies whether the decision maker unit was on the efficiency line or out of efficiency line? By this, we can separate efficient units from inefficient units. In order to examine the productivity of Cooperative development branches in Golestan province, malmquist productivity index is used. In this regard, if productivity changes using malmquist index is larger than one then performance improvement is positive and the firm's business has grown. If it is less than one then there is reduced performance. If it is equal to one there have been no changes in the productivity.

The following relations are used to calculate the productivity of all factors and efficiency:

Productivity changes=technological changes*changes in technical efficiency of production

Technical efficiency changes= management efficiency changes*scale efficiency changes

Productivity changes=management efficiency changes*scale efficiency changes*technological changes.

So for calculating efficiency we need inputs and outputs. In this regard, inputs are number of personnel, current account deposits, saving account deposits, long term deposits and short term deposits. Output variables are loans and current credit facilities, past due receivables and delayed receivables. At the end, for presenting an appropriate model in order to ranking bank branches DEA results will be used.

Approaches

The DEA methodology has made great theoretical advances, allowing for its application to a range of real world problems including those of the banking sector. Consequently, DEA has become one of the most widely used approaches to measure the efficiency of financial institutions. Whereas DEA branch analysis is applicable to a very broad range of business objectives, including the assessment of intermediation, cost, profitability, and resource

allocation efficiencies and the identification of possible sources of inefficiency.

DEA has found applications in many areas of study. It has also been subject to numerous theoretical advances and methodological extensions. Most notably was the development of the BCC model, which allowed for variable returns to scale.

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