

## Efficiency of Tejarat Bank: Semi-Parametric Approach

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### ABSTRACT

The aim of this research is to measure the extent to which macroeconomic environmental variables including inflation rate, unemployment rate, economic recession and Tejarat Bank employees' educational level are affected by the efficiency of the Bank's branches. first measured the technical efficiency of the selected branches has been made Over 46 branches of Tejarat Bank in the city of Tehran by using the Data Envelopment Analysis (DEA). at the next stage, the model has been evaluated, and the effect of the macroeconomic variables including inflation rate, unemployment rate, gross domestic product and the Bank working employees' educational level on the efficiency of the branches has been tested. The results show a meaningful relationship between the variables and the efficiency of the branches.

**KEYWORDS:** Bank Efficiency, Semi parametric model, Macroeconomic.

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### INTRODUCTION

Efficiency index is important because it acts as a sign in manner of using bank resources in order to achieve maximum profit. Representing accurate and practical strategies to improve performance of an institution is one of the most significant elements for evaluation process of institution's performance. Data envelopment analysis (DEA) is a reliable method in measuring the relative efficiency of similar institutions based on inputs and outputs (Pastor et al, 2001). In this method a border consisted of methods of institutions with best relative efficiency is obtained by means of mathematical programming models (Charnes et al, 1978). This border is considered as a criterion in evaluation and representation of strategies to improve performance of other institutions. No prejudgment is occurred about institutions under study in data envelopment analysis (DEA) because production function is not used. Thus, DEA models have a special importance in evaluation of institutions because of using fewer hypotheses with regard to similar models. During the recent years semi-parametric approach has been introduced for more accurate measurement with regard to previous methods according to which effect of exogenous variables (environmental) are considered in addition to endogenous variables (including the applied variables in DEA) (Simar et al, 2007). Subjects of efficiency were proposed in a compiled and systematic form by studies of Debbro and Kapmans and were continued by Farrel in 1957 but practical possibility of measuring it was provided in 1977 (Stochastic Frontier Analysis) and 1978 (linear programming method).

In this survey we try to find the relationship between macro-economic variables and banking with efficiency changes of bank branches while measuring efficiency of each branch under study. Concept of efficiency and its types as well as panel data will be studied in research literature. Given to importance of the issue and its cohesion, two hypotheses could be proposed. Based on the first hypothesis, technical efficiency of branches is increased by enhancement of their degree in terms of the existing administrative principles and rules. Also significant relationship between inflation rate and economic stagnation with efficiency of branches is examined in the second hypothesis.

### 2- RESEARCH LITERATURE

In 1978 three specialists of operational research represented practical measurement of efficiency in an article by means of linear programming. Efficiency deals with the manner of performance of an economic unit in production process. In other words it is the manner of performance of production process elements and optimal combination of them in achieving maximum production. Production is efficient when we can have the best application of amount of labor force and capital for production and increase production technically by such available possibilities, i.e. being under optimal Pareto conditions (Henderson et al, 1929). Types of efficiency include the following cases:

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Technical efficiency that shows capability level of a firm for production maximization given to specified production factors; Allocative efficiency that measures capability of the firm to use optimal combination of production factors given to their price; economic efficiency is obtained by multiplying technical and allocative efficiency; structural efficiency is applied in industry and is obtained from weight average of efficiency of firms in that industry. We can study efficiency of various industries with different products by means of structural efficiency (Emami Meybodi, 2001). Numerical amount of technical efficiency, economic efficiency and allocative efficiency is between zero and one. Changing the unit of measurement (for example considering number of workers in the form of person-hour instead of worker in year) won't change the efficiency level. Also, amount of technical efficiency based on minimization of production factor or maximization of product that has been stated by Farrell is equivalent to functions of production factor-product stated by Shephard. These cases have been important in subjects related to manner of using DEA method in calculations of Malmquist index in order to determine Total Factor Productivity (TFP). DEA method is based on a series of optimization through linear programming which is called non-parametric approach too. In this method efficient border curve is created from a series of points that are determined by linear programming. It is possible to use two hypotheses of constant return scale and variable return scale to determine the points. Linear programming method determines whether the intended decision making unit is placed on the efficiency line or is outside of it after a series of optimizations. Thus, efficient and inefficient units are separated from each other. DEA technique covers all data (numbers and information) and because of this is called data envelopment analysis. In addition to measure efficiency we can measure productivity for each firm in this method by means of Malmquist index and divide productivity changes into two sections of changes resulted from efficiency and technology. Also calculation of efficiency and productivity for the firms with several outputs is possible by DEA. Equality of number of data in each section is not necessary and also we can have variables that are fixed in a section for a time period (Nerlove, 2000). The above descriptions confirm conditions of this survey to use panel data for more accurate research in this field.

### 3- Experimental studies

Hadian and Azimi (2005) studied position of ten specialized and commercial banks of the country for the time period 1998-2000 in a survey by means of data envelopment analysis method. Results of this research show that specialized banks have had a better situation than commercial banks in terms of technical, allocative and economic efficiency.

Haghighatju and Nasiri (2004) estimated technical efficiency of 172 branches of Keshavarzi Bank through data envelopment analysis method by means of cross section data in 2003. results of the research illustrated that urban branches had higher average efficiency than rural branches.

Khamesian (2004) measured technical efficiency of some branches of Parsian Bank in which technical efficiency was measured in three time periods of 2004, 2005 and 2006. Results demonstrate that average efficiency of branches has been increased by time.

Manthos and Nikolas (2007) study banks of ten countries that have recently been joined to European Union in a paper entitled "measuring bank's efficiency: semi-parametric approach". This research was performed in the time period 1994-2005. Manthos and Nikolas studied the effect of environmental variables on banks' efficiency in two steps through semi-parametric approach. Average efficiency of banks in the proposed countries is increasing. After estimating Simar and Wilson model, results show that there is a positive relation among the bank's efficiency and index of bank information, assets, interest rate and ratio of total investment to gross domestic product and the relation between bank's efficiency and ratio of debt waste to the total debt variable is negative.

In another research entitled "comparative study of efficiency in Europe banking" by Casu and Maximum likelihood (2000) through data envelopment analysis, efficiency in bank systems of Europe that follow the European Union rule was measured from 1993 until 1997. Obtained results of this research show that efficiency of the proposed banks has been increased 6.3% in input-oriented research and 6.6% in output-oriented research with a few modifications. In recent studies by using data envelopment analysis method to measure European Banks, Berg (1993) obtained the average efficiency of 58%, 78% and 89% for Finland, Netherlands and Switzerland; the Europe Commission (1997) obtained 73% of average efficiency for European countries; Pastor (1997) obtained 79% and Diestch and Weill (1998) obtained 64% of average efficiency for the European countries in 1996. Obtained results revealed that in 1993 difference of efficiency related to the highest efficiency of English banks and the lowest efficiency of Spanish banks was equal to 19.1% in banking systems in Europe, while difference of efficiency in 1997 between England and Italy was equal to 26.6%. Also by estimating Tobit model it was concluded that the most important effective factors on efficiency are local position (various countries).

David Haner (2004) studied and compared cost and scale efficiency among the big banks of Germany and Austria in 1995-1999. Research results show that average efficiency of Austrian banks and German banks has been 42 percent and 66 percent respectively. Results of the model illustrate that factors like specialization of the bank, risk or volatility of return on asset, bank's ownership type, percentage of banking debts and interbank savings from the whole assets of the bank and also quality of employees affect high efficiency of German banks.

**4- Introduction of the model and research methodology**

Measuring efficiency based on output oriented means that the proposed industry is under conditions in which it tries to increase outputs in order to enhance efficiency and fix production factors. Efficiency of selected branches of Tejarat Bank has been studied in this survey in a way that banks' branches have fixed inputs and can't decrease their box-offices and personnel (who are formal employees), thus they prefer to fix inputs given to the investment that they have done on inputs. Therefore, it is realistic and practical to try to keep inputs stable by increasing of products. Technical efficiency has been measured based on outputs maximization given to this issue. Efficiency based on input-oriented or output-oriented method is measured with two assumptions of constant return scale (CRS) or variable return scale (VRS). Banker, Charnes and Cooper (1984) generalized CCR model to include variable return scale. Using the assumption of constant return scale will disorganize the calculated amounts for technical efficiency of analysis (including efficiency of the scale) when all firms don't act in optimal scale. Using variable return scale will represent a very accurate analysis by calculating technical efficiency in terms of amounts of efficiency resulted from scale and efficiency resulted from management. Performing this in formulation of Dogan problem with regard to linear programming by constant return scale assumption, calculations are done with variable return scale assumption by adding limitation  $1 = \lambda \sum N_i$  (convexity constraint) to linear programming with the condition of constant return scale. Variables of the model are constituted from two groups: the first vector is inputs that include number of box-offices and employees of the branch and the second vector is outputs that consist of term-long deposit, interest free saving deposit, demand interest free deposit, guaranty cash deposit and amount of outstanding demands. In the second step variables are defined in two groups. The first group is banking industry variable including education level of bank employees and the second group are macro-economic variables including inflation rate, stagnation (amount of gross domestic product) and unemployment rate. This step is the continuation of the second step and obtained technical efficiency from the first step for each branch is inserted in the model as dependent variable. Then environmental variables including inflation rate, gross domestic product, education level of bank employees and unemployment rate are inserted in the model as independent variables.

**5- Model estimation and analysis**

Forty six (46) branches of Tejarat Bank located in 4<sup>th</sup> zone of Tehran were studied in three periods of 2004, 2008 and 2010 in two steps. First, technical efficiency of each branch was measured and its reasons were examined. Then in the next step that was innovation of this survey a model was estimated based on panel data which illustrated the relation of environmental variables with technical efficiency. After measuring technical efficiency among 138 observations, six branches were efficient. These branches succeeded to reach themselves to efficiency border because of high extant of deposits and granting facilities to their customers as well as good and increasing growth of extant of guaranty cash deposit. The most efficient branch among the six efficient branches during each of these three periods under study is as table (1). Outputs of branch number 41 have always been increased in addition to the fact that it has been a reference for most branches in two periods. Facilities' growth of this branch in 2008 with regard to the previous period has been 723%, demand deposits have been 300% and guaranty cash deposits have been 40%.-termlong deposits have 763% growth in the period in 2010. Indeed growth of the above outputs is the major reason of efficiency of this branch in all periods under study. Also, average technical efficiency of the studied branches has a decreasing trend based on table (2) and dispersion level of branches under efficiency border has an increasing trend according to diagrams 1 to 3.

**Table 1- names of the most efficient branches**

Year	Branch-code
2006	Branch No. 41
2008	Branch No. 41
2010	Branch No. 34

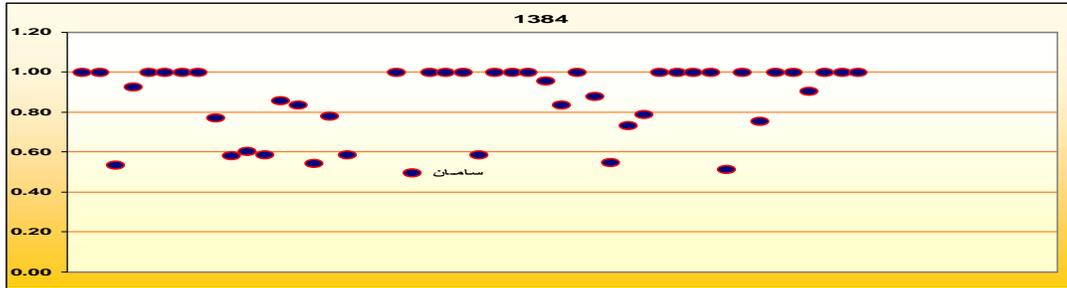
Source: research findings

**Table 2- average technical efficiency of branches**

Year	2006	2008	2010
average technical efficiency	0.811	0.751	0.643

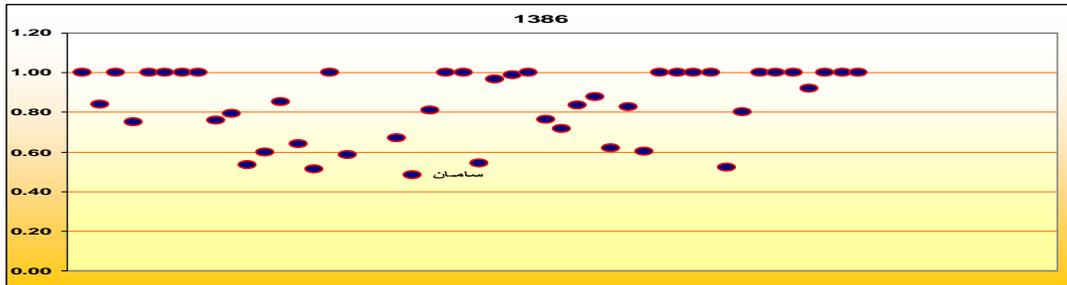
Source: research findings

**Diagram 1- dispersion of branches and their distance from efficiency line in 2006**



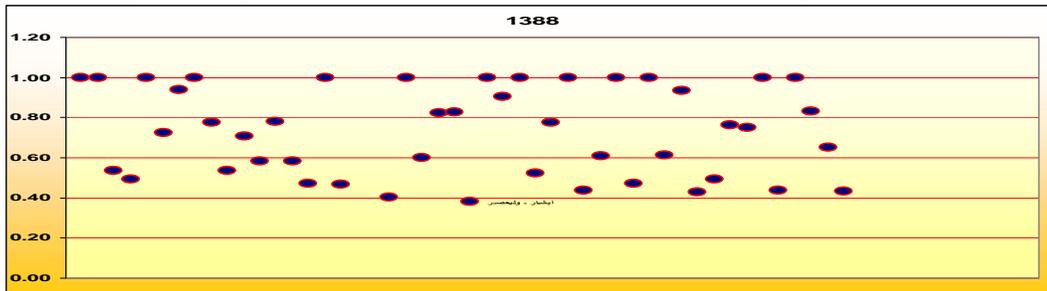
Source: research findings

**Diagram 2- dispersion of branches and their distance from efficiency line in 2008**



Source: research findings

**Diagram 3- dispersion of branches and their distance from efficiency line in 2010**



Source: research findings

Decreasing of average efficiency of the proposed branch could have several reasons. Changes of economic conditions and reduction of employees' productivity given to the research framework have been studied in outputs of the model. Table (3) shows growth of outputs in each period with regard to the previous period and the result shows reduction of average efficiency because of increasing of outstanding demands that obstructs resources and decreases profitability of the bank. Among the other factors we can refer to reduction of granting facilities in the framework of anti inflationary policy of the government as well as reduction of demand deposits that shows decreasing of transactions. So the first hypothesis regarding increasing efficiency of branches proportional to increasing of their degree in terms of administrative principles is rejected in this section.

**Table 3- sum of outputs growth in branches**

Description	Facilities	Savings deposit	term-long deposit	Demand deposit	Guaranty cash deposit	Outstanding debts
Growth in 2008	-13%	-13%	47%	40%	55%	279%
Growth in 2010	6%	52%	59%	-2%	31%	140%

Source: research findings

After estimating this model with panel data, the following model was estimated:

$$\text{Efficiency} = 4.28\text{E}.06 \text{ GDP} + 0.003 \text{ Level} - 0.059 \text{ Unemployment} - 0.033 \text{ Inflation}$$

Obtained model shows that the most negative effect on technical efficiency of branches is related to inflation rate and unemployment rate that are an index of economic stagnation and technical efficiency of branches is decreased by increasing of them. According to table (4), names of independent variables including gross domestic product (GDP), unemployment rate, inflation rate and education level of employees of the bank are mentioned in variables column.

**Table 4- results obtained from estimating the model**

Variable	Coefficient	Std.Error	t.Statistic	Prob.
<b>GDP</b>	4.28E.06	3.91E.08	109.4127	0.0000
<b>UNEMPLOYMENT</b>	-0.059108	4.31E.05	-1370.027	0.0000
<b>INFLATION</b>	-0.033437	0.000174	-192.7196	0.0000
<b>LEVEL</b>	0.003115	0.000519	5.998441	0.0000

Source: research findings

Internal gross domestic product means increasing of production, consumption, investment and creating value added in the whole economic activity of different sectors that increases capability of competitiveness and efficiency. Under such conditions demand for receiving facilities by producers and traders from banks is enhanced that increases investment demand. Since banks supply this capital granting facilities is increased in the form of various contracts. Given to conditions of the market under economic prosperity conditions, producers offer their products to the market and sell them. As a result, producers as well as traders will be able to repay installments of facilities they have received. This means timely return of resources of the bank along with their interest. On the other hand, if gross domestic product is increased, saving of the society will be enhanced because of enhancement of income level.

When saving is increased it means increasing of bank resources that are represented as deposit in types of long-term deposit, interest free saving and current accounts. Increasing of bank resources due to depositing of bank customers from one side and return of the original and interest of resources that are paid in the form of facilities to investors from the other side strengthen the bank outputs. In other words, economic growth is led to economic prosperity which is among the important reasons in increasing of banks' efficiency. Increasing of economic prosperity means enhancement of export, import and international trade indexes of countries. Enhancement of commercial trade means increasing of receiving bank services' commission from customers by the banks which is among their profitability resources. Increasing of gross domestic product resulted from economic prosperity could be in the benefit of banks and increases their efficiency. Coefficient of unemployment rate is equal to -0.059 and means the reverse effect of unemployment rate on technical efficiency of branches. Increasing of unemployment rate means intensification of economic stagnation, thus technical efficiency of banks is decreased. Increasing of unemployment rate is the result of stagnation dominance in the economy as a result of which producers and traders who have received facilities from the bank won't be able to repay loan installments. Therefore, outstanding demands of banks will be enhanced. Dominance of economic stagnation increases unemployment rate that is occurred because of reduction of capacity or shutting down of manufacturing, service and commercial firms. Consequently, capability of firms that have received facilities from the bank is decreased in returning resources of the bank. In this state not only the original resources given to customers by the banks are not returned totally but also banks' profitability will be endangered. On the other hand, economic stagnation reduces activities in commercial affairs of the society. Also, international trades in the form of export and import will be decreased considerably. So the bank will suffer a loss in this state. In time of increasing unemployment that is the result of economic stagnation, outstanding demands of banks have an ascending process in addition to reduction of banks' profitability. Outstanding demands mean confinement of the bank resources and limitation in applying of such resources in cash flow. These conditions show reduction of production, increasing of unemployment, decreasing of efficiency and operational power of banks and helping to permanence of stagnation in economy. It increases banks' demands and risk of granting facilities for the banks that is led to more strictness of banks in granting facilities in the form of different contracts to their customers. Thus, one of the important and effective factors in banks' efficiency changes that are affected by environmental variables too is outstanding demands. High inflation rate means losing of money value, so the higher the inflation rate, the less the real value of deposits that people have given in trust to the banks for investment. This reduction of value for depositors and their original owners is compensated with allocation of different interest rates based on

the kind of deposit. But such value reduction is not reparable for the bank, because a percentage of bank resources can not always be operationalized because of various reasons such as legal reserve by the Central Bank, precautionary reserve, outstanding demands and interbank accounts. In other words, efficiency of branches is decreased by increasing of inflation rate. Enhancement of employees' knowledge and education in organizations and institutions increase quality in offering services. Banks are not excluded from this issue, as it was observed in table (4) coefficient of educational level of bank employees is positive and equal to 0.003. It means that by increasing one unit of employees' education level, technical efficiency of branches is increased 0.003 units. Among the prominent characteristics of educated employees we can refer to self-confidence and innovation. These employees offer applied and helpful ideas if a problem is occurred and help their organization progress by innovation in working. Using employees with high educational level could help strengthen the expertism section of the bank, higher glorification of customers, the ability to create innovation in work and having successful applied ideas. Each of the above-mentioned factors enhances efficiency level of the bank. Relationship between efficiency and educational level of bank employees has been confirmed significant in this survey. In table (5) we observe standard deviation (std.error). Variance is dispersion criterion and reliability of estimators. Whatever this amount is higher, capability of reliance on it is lower. According to the definition and given to coefficients obtained for independent variables of research, these coefficients have a high reliance capability. In t.statistic column in table (4) that shows hypothesis of coefficient  $H_0=0$ , absolute value of coefficients is higher than 2 which shows high relationships of coefficients with the model. In this section effect of all independent variables on technical efficiency of branches is confirmed. Prob column shows percentage of possibility of error type one and illustrates the possibility that obtained coefficients are unrelated which have been recognized as being effective and related erroneously. As it is observed, in this column prob=0 was obtained for all variables of the model that means nonexistence of error type one and shows high significance of variables. Amounts lower than 5 percent for this column mean nonexistence of error type one in calculations. Prob=0 demonstrates high precision of estimation. In addition to paying attention to each variable, suitability of the model's goodness must be considered for more confidence towards research results. Table (5) shows amount of variables that determine suitability of the model's goodness.

**Table 5- results of model estimation**

<b>R-squared</b>	<b>0.217344</b>	<b>Mean dependent var</b>	<b>1.079259</b>
<b>Adjusted R-squared</b>	0.199821	S.D.dependent var	<b>0.793398</b>
<b>S.E.of regression</b>	0.188724	Sum squared resid	<b>4.772643</b>
<b>Durbin- Watson stat</b>	<b>1.067795</b>		

Source: research findings

R-squared or obtained  $R^2$  is equal to 0.21. It is obvious that the lower the  $\sum e^2$ , i.e. if error term of the model is lower,  $R^2$  is larger and goodness of the model is better. But lowness of  $R^2$  in this model is not equal to unsuitability of goodness rather its reason is low range of efficiency changes in distance 0 and 1. Thus, low  $R^2$  because of low range of efficiency changes creates no problem in the model (Mohammadi et al, 1994). Standard error of regression shows closeness to regression line and whatever its amount is lower it demonstrates goodness of the model and closeness to regression line that in this state with amount of 0.189 is an acceptable amount of goodness. It means closeness of the estimated model to the regression line.

## 6- Conclusion and political recommendations

This survey illustrates that all branches among the efficient ones in the proposed period don't have prominent degrees in terms of administrative principles even the most efficient branch of the zone during the whole proposed period had the lowest degree among the zone's branches. Reason of this difference could be investigated in manner of rating. In other words, rating of branches in terms of administrative principles is just based on amount of increasing of deposits and facilities as well as reduction of demands without considering inputs (based on Tejarat Bank's circular letter) while measuring efficiency of branches based on scientific principles is different. Considering efficient and successful branches as a model is effective to increase efficiency level of inefficient branches. Those branches that have maximized outputs with constant inputs are placed on efficiency line. In other words they are close to optimal Pareto conditions.

Increasing efficiency of branches by increasing of gross domestic product is due to enhancement of production, consumption, investment growth and creating value added in various economic sectors and could have a positive effect on competitiveness capability and efficiency enhancement. The obtained coefficient for inflation rate means that by increasing one unit of inflation rate, technical efficiency is decreased. Whatever the inflation rate is higher, real value of deposits that people have given in trust to the bank to perform investment will be decreased. Higher inflation rate will lose real value of deposits for the bank and reduce banks' profitability. To put it differently, increasing of inflation rate intensifies problems of the banking system so increasing efficiency of bank related to gross domestic product growth and decreasing inflation rate.

The obtained coefficient for unemployment rate means reverse effect of unemployment rate on technical efficiency of branches, that is technical efficiency of branches is decreased by increasing of unemployment rate, i.e. intensification of economic stagnation. In times of increasing unemployment that is the result of economic stagnation, outstanding demands of banks has an ascending process in addition to reduction of banks' profitability. Increasing of demands in economy that is one of the consequences of economic stagnation causes to reduce banks' efficiency. These conditions are led to more strictness of banks in granting facilities in the form of various contracts to their customers. Also educational level of bank employees has a direct and significant relation with efficiency of branches. Among the prominent characteristics of educated employees we can refer to self-confidence and innovation. These employees offer applied and helpful ideas if a problem is occurred and help their organization progress by innovation in working. Using employees with high educational level could help strengthen the expertism section of the bank, higher glorification of customers, the ability to create innovation in work and having successful applied ideas. Each of the above-mentioned factors enhances efficiency level of the bank. In service education of employees to improve banking knowledge level and also employing human force with higher education are among the policies that bank managers must follow, because improving of education of bank employees with due regard to the obtained results increases efficiency of branches considerably.

Findings of the survey illustrate the necessity of change in the manner of current rating of Tejarat Bank branches. It is recommended to prepare rating of the branches based on compiled indexes by giving privilege with regard to efficiency in regional comparison and is referred as a complementary method besides the current rating of branches. Similarly effect of outstanding demands on reduction of the bank's performance as well as reduction of profitability and technical efficiency of branches based on results of the present survey necessitates more precision of managers of branches in exact valuation of applicants for facilities. Results of this survey indicate that banks are affected by macro economic variables in terms of efficiency. Hence, economic policy makers should consider changes of these variables, as instability of macroeconomic variables will harm banks.

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