Journal of Industrial and Systems Engineering
Vol. 17, No. 2, pp. 14-25
Spring (April) 2025

JISE

Evaluation of Factors Affecting the Performance of the Banking System in Iran with a Productivity Index Approach

Ahoo famil Bakhtiyari [1], Kambiz Hojabrkiani [2,*], Abbas Memarnegad [3], Farhad Ghaffari [4]

[1] *Department of Economics, Science and Research Branch, Islamic Azad University, Tehran, Iran.*

[2] *Department of Economics, Science and Research Branch, Islamic Azad University, Tehran, Iran.*

[3] *Department of Economics, Science and Research Branch, Islamic Azad University, Tehran, Iran.*

[4] *Department of Economics, Science and Research Branch, Islamic Azad University, Tehran, Iran.*

Abstract

Before the global financial crisis, high levels of operational productivity, profitability, and market values raised doubts about the accuracy of banking performance assessment. Consequently, methods for examining the efficiency, productivity, and effectiveness of banking operations have attracted the attention of policymakers and researchers in the banking field. Resource limitations on the one hand and the increasing demand for them on the other hand highlight the importance of focusing on productivity in various dimensions of an economy. Given the undeniable significance of productivity in the banking system of the country, this research aims to investigate the factors affecting the productivity of a selected group of banks listed on the Tehran Stock Exchange, using the Solow residual approach throughout 2010-2017, employing the Generalized Method of Moments (GMM). According to the results of this study, labor force, capital accumulation, and return on assets positively impact the productivity of the selected banks, while the number of branches was found to be statistically insignificant. Finally, some recommendations are provided.

Keywords: Productivity; Solow residual method; Generalized Method of Moments; Total Factor Productivity

1- Introduction

Considering the Importance of the Banking Sector's Role in National and International Economic Systems. Given the increasing importance of the banking sector in national and international economic systems, policymakers, researchers, and banking professionals are increasingly seeking to identify the most effective actions for better bank management. This effort gained more significance after the global

* Corresponding Author

financial crisis of 2008 and its impact on important financial and accounting indicators in the banking industry worldwide. Following the recent global financial crisis, countries found it necessary to implement a process for restructuring banks and a series of reforms based on specific banking regulations. This process includes both prudential and structural regulations and must comply with a set of laws to ensure appropriate levels of asset quality and resources to cover potential losses and maintain bank stability (Peres & Gomez Garcia, 2019).

One of the key characteristics of effective management in various economic entities, including the banking sector of any country, is productivity. A review of existing studies shows that most focus on productivity in developed countries, while less attention has been given to the banking sector in developing countries (Aparjese & Palmis, 2016; Chen et al., 2018; Movahed et al., 2023).

Resource limitations on one hand and the increasing demand for them on the other hand highlight the critical importance of focusing on productivity. Therefore, improving productivity should be institutionalized as a national movement at all levels of society, from the highest levels of government policy and planning to individual activities. Banks are no exception to this rule, and in the pursuit of establishing private banks and increasing competition complexity, their only way to gain a larger market share, increase profitability, reduce costs, enhance customer satisfaction, and ultimately achieve excellence is to pay more attention to the issue of productivity (Fathi, 1390).

As Bernolak states, "Productivity means how well we have produced good outputs from the resources used. If we produce better and more goods and services using fixed resources, or if we provide the same amount of goods and services with fewer resources, we have increased productivity." Therefore, productivity refers to the efficient and effective use of inputs or production factors. According to economic growth theories, production can increase in two ways: the first axis is the quantitative increase of inputs, which requires an increase in employment and physical capital. The second axis is the enhancement of Total Factor Productivity (TFP), which involves better utilization of existing capacities through improving the quality of production inputs and structural reforms (Dezhpasand et al., 1398; Nozari et al., 2024).

Regarding Iran, data from a selected group of banks indicates that the overall productivity of banks has increased during the examined period. However, the quantitative use of some resources in banks has shown a decreasing trend, while others have shown an increasing trend.

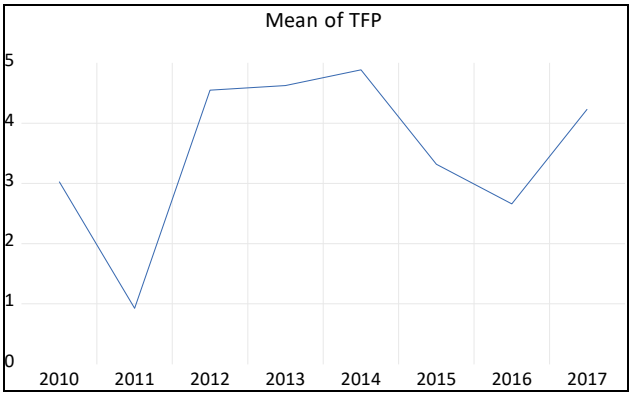


Chart 1. Total Productivity of the Group of Banks Listed on the Tehran Stock Exchange

Therefore, examining the impact of various factors on productivity within a group of banks under different conditions allows for more accurate results that can be generalized to other groups. Consequently, this research aims to assess the impact of capital adequacy, number of branches, employment levels, and return on assets together on the total productivity of production factors within a selected group of banks listed on the Tehran Stock Exchange. Now, the question arises: how has the overall productivity of the group changed, considering the increasing and decreasing trends in various bank resources? What is the impact of each of these factors on the overall productivity of banks? And which factor holds greater importance compared to the others? In this context, the organization of this article is as follows: in the

second section, the theoretical foundations and then the research background are presented. The fourth section explicitly discusses the model, introduces the variables, and outlines the research methodology. Finally, the results of the research and recommendations will be presented.

2- Literature Review

There is a vast literature on bank productivity using various samples, and numerous studies have been conducted on bank productivity and its explanatory factors in both developed and developing countries. According to the definition by the European Productivity Agency and the Japan Productivity Center (JPC), productivity is a social concept introduced as a mental attitude. This concept aims to improve things that already exist and emphasizes that individuals can perform better day by day; in other words, becoming better every day than the day before. In 1995, three definitions related to productivity were proposed: 1) Productivity is the ratio of output to input. 2) Productivity is a combination of efficiency and effectiveness, defined as the ratio of production to input plus the ratio of production to goals. 3) Productivity encompasses a broader concept, whereby anything that contributes to the creation of an organization performs better. Additionally, the Asian Productivity Organization (APO) defines productivity as follows (Roghanian et al., 2012):

Productivity = Efficiency + Effectiveness = Doing the right things + Doing things right.

The term productivity has different meanings from various perspectives. The International Labour Organization defines productivity as: "Productivity is the ratio of output to one of the factors of production (land, capital, human resources, and management)." In this definition, the ratio of production to each of these factors serves as a measure of productivity. Overall, it can be said that different products are produced by combining four main factors: land, capital, labor, and organization (management and technology). Therefore, the ratio of output (production or value added) to these factors serves as a measure of productivity (Shahabinejad et al., 2015). Enhancing the productivity of financial markets plays a significant role in the country's economy, and given the bank-oriented nature of the country's financial system, understanding ways to measure and increase productivity levels in banks is of great importance.

Banks, as one of the economic entities, must consider productivity in their strategies and actions. In the contemporary world, banks play a significant role in the growth and development of economic systems; as today, economic growth, increased welfare, and improved living standards in any country depend on the level of investments, which are primarily facilitated through the collection of deposits and savings from millions of individuals who, for various reasons, lack the ability or opportunity to invest. The banking network, by collecting these scattered resources and making them available to investors, creates the necessary conditions for investment growth and ultimately enhances national income and community welfare. Without a suitable banking network, it is impossible to mobilize small savings and transfer them for investment. In developing countries, the role of these institutions becomes even more critical. Due to the low per capita income in these countries on one hand and the high propensity to consume on the other, the level of savings and financial resources for capital mobilization is limited and scattered. Therefore, banks and financial institutions play a more vital role in mobilizing domestic resources and optimally allocating them to productive investments (Chang et al., 2012). Accordingly, this study aims to focus on productivity and the factors affecting it at the banking level within a selected group of banks.

2-1-Different Perspectives on Productivity

Generally, three broad perspectives on productivity are presented as follows:

Productivity from a systemic perspective has a more complex nature and is discussed within the entire system. In this view, productivity is defined as the ratio of the total outputs of a system to its inputs. This definition applies to various social, cultural, and industrial systems. The numerator, which represents the outputs of the system, can be defined in physical terms (such as volume of product, number of graduates, etc.), while the denominator (representing inputs) can include quantities of raw

materials or hours of labor and machinery. Alternatively, these can be measured in terms of monetary value or the currency unit prevalent in each country.

From a systemic perspective, productivity exists in an environment with various and changing characteristics. Different production factors such as labor, capital, energy, management, technology, etc., are utilized as inputs in the production process, resulting in outputs such as manufactured goods and services. Certainly, if this system can qualitatively and quantitatively change and adjust its inputs and outputs, it can enhance its productivity.

2-2-Productivity from the Japanese Perspective

According to this perspective, productivity cannot be increased without focusing on quality improvement and waste reduction. Competitiveness in the market can be enhanced by addressing the issue of quality enhancement. Therefore, waste reduction is incorporated into the productivity formula.

$$P = \frac{Y}{L} \tag{1}$$

In this relationship, Y represents output (produced goods), L represents labor (hours worked), and P is the productivity index. The Japanese have included the waste factor in the numerator to account for the impact of quality on productivity, where Y = T - D, with T being the total volume of production, D being waste, and Y being the good products. Therefore, as waste decreases, the numerator increases, leading to higher productivity. Additionally, another relationship is introduced in this perspective, which does not consider the worker as the sole labor factor and also incorporates the management factor.

$$P = \frac{S}{L + M} \tag{2}$$

In relation (2), S represents the price of goods and services sold in the market, L represents labor, and M represents management. Therefore, from the Japanese perspective, to increase productivity, attention must be paid to the quality of labor, management, and the structure of other production factors that constitute the cost price. These approaches lead to the historical Kaizen approach (continuous improvement) and total quality management.

2-3-Economic Approach to Productivity

From an economic perspective, the amount of output or production is assumed to be a function of capital and labor factors. If we assume Q is the amount of production, K is capital, and L is labor, then Q = f(K, L). From this viewpoint, the amount of production is a function of capital and labor. Therefore, increasing the skill level of the labor force, technological changes, or enhancing skills alongside technological improvements can lead to an increase in production quantity and shift the production function upward, thereby increasing productivity. Generally, today, productivity represents an economic, technical, and cultural perspective on production, where humans perform their activities intelligently and wisely to achieve the best results with the least cost and in a shorter time (Taheri, 1397).

2-4-Calculation of Total Factor Productivity

There are various methods for measuring productivity, each with its characteristics, advantages, and specific difficulties, such as the Solow growth accounting method, Divisia method, Tornqvist method, DEA method, and Malmquist method, among others (Kimiagari, 1388). Solow (1975) used the Cobb-Douglas production function to decompose production growth based on the contributions of production factors (capital and labor) and a residual factor called technological progress. The Solow method decomposes total production growth into growth in inputs and growth due to technological advancement, becoming a standard method for measuring technological progress or growth in total factor productivity. Johnson (2010) states that Solow considers the production function f(A, K, L), where A represents the level of technology or TFP, and K and L represent the amounts of capital and labor used, respectively. Thus, the total production function (Y) is expressed as relation (3):

$$Y = f(A, K, L) \tag{3}$$

If we assume that the variables Y, K, A, and L are differentiable concerning time, the derivative of this equation can be obtained as follows:

$$\frac{dY}{dt} = \frac{\partial Y}{\partial A}\frac{dA}{dt} + \frac{\partial Y}{\partial K}\frac{dK}{dt} + \frac{\partial Y}{\partial L}\frac{dL}{dt} \tag{4}$$

Now, the growth rate of $\gamma_Y = \frac{dY}{dt}\frac{1}{Y}$ is defined. Similarly, we can express the growth rates for γ_A و γ_K و γ_L It is proposed. Then this relationship is divided by Y:

$$\gamma_Y = \frac{\partial Y}{\partial A}\frac{dA}{dt}\gamma_A + \eta_K\gamma_K + \eta_L\gamma_L \tag{5}$$

The production elasticity concerning capital and labor is considered. Assuming Hicks-neutral technological progress, the production function is obtained in the form of f(A, K, L) = AG(K,L) such that$\frac{\partial Y}{\partial A}\frac{dA}{dt} = 1$ and the equation can be written as follows:

$$\gamma_Y = \gamma_A + \eta_K\gamma_K + \eta_L\gamma_L \tag{6}$$

The share of technological progress in the share of production growth is expressed as the part of production growth that is not defined by the growth of inputs (Vafai et al., 2017):

$$The\ solow\ Residual = \gamma_Y - \eta_k\gamma_k - \eta_L\gamma_L \tag{7}$$

In this section, we review several internal and external studies that are somehow related to the present research topic. Al-Khasaneh et al. (2020) examined the productivity characteristics of several banks in the United States from 1992 to 2003. The results of this study indicate that merged large banks have similar productivity compared to their peers, while smaller banks undergoing mergers have lower productivity. Jreisat et al. (2018) investigated the factors affecting total factor productivity in 14 Egyptian banks during the years 1997 to 2013. They concluded, using data envelopment analysis, that the ratio of bank loans to bank deposits, the size of banks, and the age of banks have a positive and significant impact on productivity, while the net interest margin and non-interest expenses do not significantly affect productivity. Additionally, Akinwunmi (2017) studied the factors affecting bank productivity in Nigeria during the period from 2001 to 2015. This study concluded that efficiency ratio, credit risk, and capital adequacy are among the key factors affecting bank productivity in the long term. Furthermore, capital adequacy has a significant impact on productivity among the mentioned factors.

Das and Patra (2016) also examined the productivity and efficiency of 26 public sector banks in India following the global financial crisis. They found that productivity and efficiency changes among public sector banks vary significantly, and some suffer from inefficiency due to ineffective policies. Al-Hassan and Biekpe (2016) studied productivity changes in 18 banks in Ghana from 2003 to 2011. Using panel regression analysis, they concluded that bank size, concentration, income diversification, and risk are among the factors affecting productivity changes among Ghanaian banks.

Among domestic studies, Dezhpasand et al. (1398) examined the factors affecting productivity in a selected group of banks in Iran during the period from 1388 to 1392. This

research identified the role of human capital, electronic banking technology, the scale of operations, the degree of financial asset rigidity, the ratio of expenditures to resources, and the economic recession and boom in improving total factor productivity using panel data.

Faghiljou and Kalantari (1398) investigated the trends of efficiency and productivity of banks in Iran. According to the results of this study, the type of approach to selecting inputs and outputs, and whether or not to consider risk as an undesirable output, significantly affects the performance assessment of banks. The average productivity in private banks is higher in intermediation and production approaches compared to state banks. Alirezaei and Najafi (1396) in a study defined a fourth factor called the balance factor of the decision-making unit and concluded that productivity growth is influenced by changes in the balance factor and the size of branches during the evaluation period. Yazdanshenas and Shojaei (1395) also identified and explained the model of factors affecting productivity in the branches of Bank Melli in Qom province. The results of this research, based on questionnaire data, showed that factors such as expertise and work experience, problem-solving ability, thinking ability, communication skills, self-regulation motivation, persistence, and creativity can significantly explain the state of knowledge productivity in the studied organization. Among these, the role of self-regulation motivation and thinking ability was more significant than other factors. Fazl Yazdi and Moein al-Din (1395) evaluated the efficiency and productivity of commercial banks in Iran using a combined fuzzy TOPSIS model, data envelopment analysis, and the Malmquist productivity index during the period from 1386 to 1390. The results indicate that among the inputs, the total assets index, and among the outputs, the outstanding loans and receivables index were of the highest importance.

The results of the review of previous studies indicate that due to the importance and position of productivity in the banking sector, this topic has always been of interest; as achieving more accurate and efficient results in this regard can lead to the adoption of more effective and correct policies. Therefore, considering the dynamic and evolving nature of productivity in countries and the continuous fluctuations, especially in developing countries, the existence of multiple studies does not diminish the value of future studies. In this context, examining and testing various theories and different models with a set of variables and in various samples provides different perspectives and conclusions, and as time goes on, models evolve towards incorporating more influential variables; thus, despite the existence of various studies in the field of productivity in different sectors, including the banking sector, this study aims to investigate the factors affecting productivity in a selected group of banks in the country.

2-5-Productivity Status in Selected Banks

Statistics indicate that the banking network in the country has been growing and developing quantitatively over time in terms of the utilization of certain inputs, while it has decreased in others. Additionally, based on the provided statistics and information, the productivity trend for each of the banks shows that some of them have not been successful in the optimal use of inputs. In Chart (2), the total number of branches and the employed workforce in the selected banks for the research during the period from 1389 to 1396 are presented:

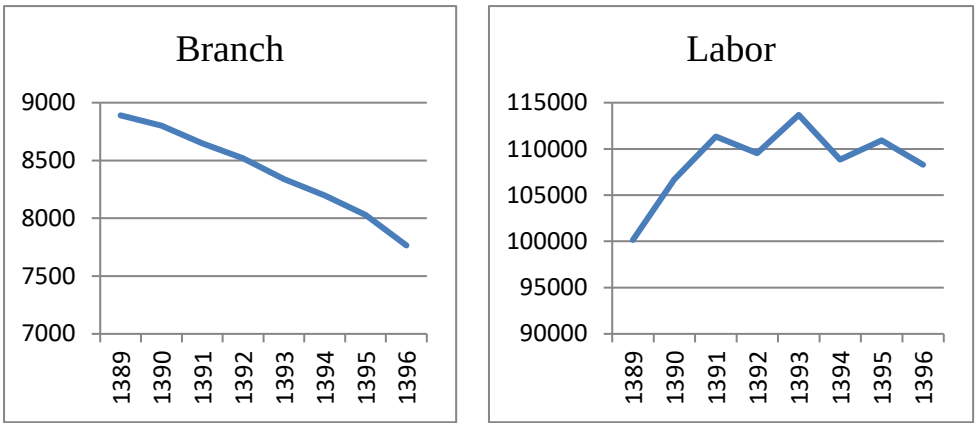
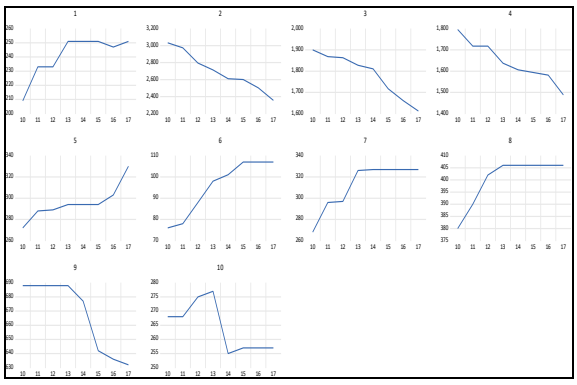
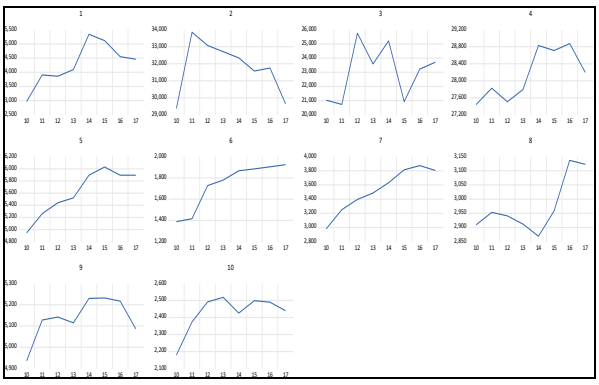


Chart 2. Total Number of Branches and Employed Workforce in Selected Banks

This information reflects the productivity and efficiency status of banks in utilizing human and physical resources and can help identify strengths and weaknesses in their performance. Furthermore, this data can serve as a basis for managerial decisions and effective policy-making aimed at improving productivity in the country's banking network. As the Chart Shows The trend of the total number of branches in the selected banks during the examined period has decreased, while the overall trend of the workforce has increased. Additionally, Chart (3) illustrates the trends of human resources and branches for each of the banks in detail.



Branch



Labor

Chart 3. Employed Workforce and Number of Branches in Selected Banks

The trend of the employed workforce in Chart (3) indicates that during the examined period, the number of employees in banks has generally increased despite numerous fluctuations. The theoretical foundations of productivity suggest that the workforce plays a crucial role in creating added value in banking. In this study, the statistics on the number of employed individuals have been used as an input indicator for labor. However, theoretical sources recommend using the actual working hours of employees for productivity calculations whenever possible, and in the absence of that, the number of employed individuals should be used as an input indicator (Central Bank, 2018).

The number of branches has increased for some banks while decreasing for others. Branches are recognized as the most important factor and pillar of profitability and marketing in modern banking. Given the losses of recent years in the banking network of the country, the interaction between branches and headquarters in banks is essential for advancing the banks' goals. On the other hand, the operational workload of bank branches, both in terms of customer interaction and the necessity of improving the quality of executive work, is greater than that of the headquarters. Therefore, the question arises: what is the impact of these inputs on the productivity of banks in a selected group with different components?

2-6-Introduction of the Model and Research Method

Many economic relationships are inherently dynamic. One of the advantages of panel data is that it allows researchers to better understand dynamic adjustments. These dynamic relationships are distinguished from other panel models by considering the value of the dependent variable as one of the explanatory variables. Therefore, this research aims to evaluate the factors influencing productivity in a selected group of banks in the country by employing a set of combined or panel data and econometric approaches for the period 2010-2017.

Considering the aforementioned points, the general form of a dynamic model in panel data for the present study, taking into account the variables of this research, is expressed as relation (8):

$$Ln\ TFP_{it} = a \ln TFP_{(it-1)} + \beta X_{it} + \mu_I + \varepsilon_{it} \qquad (8)$$

In this relation, LnTFP represents the total factor productivity of the banking system, calculated as the ratio of the sum of deposits and loans granted to the total human and physical capital. This variable is introduced as the dependent variable with one lag among the explanatory variables, and βXitβXit is a K×1K×1 vector that includes KK control variables recognized as influential factors affecting productivity. These variables include capital adequacy (K), number of branches (Bran), employment level (L), and return on assets (ROA). αα and ββ are the coefficients of the equation. єitєit represents the error term, encompassing all unobserved effects, and μiμi indicates the fixed effects for each bank. Capital adequacy (K) refers to the ratio of a bank's capital to its risk-weighted assets.

Additionally, statistical information on the number of branches of each bank is available on the respective bank's website. To measure the level of employment, the number of human resources is considered, and the return on assets is derived from the ratio of net profit to total assets. The higher the return on assets, the better the bank's operational performance will be in a positive direction. The hypotheses of this research are based on the direction and magnitude of the impact of the mentioned independent variables on total factor productivity (TFP). Therefore, the question is: do the variables of capital adequacy, number of branches, employment, and return on assets contribute to the growth of total productivity in banks?

When the dependent variable appears as a lagged term on the right side of the panel data model, the OLS estimators are no longer consistent (Arellano and Bond, 1991), and one must resort to two-stage estimation methods such as 2SLS (Anderson and Hsiao, 1981) or Generalized Method of Moments (GMM) (Arellano and Bond, 1991). The 2SLS estimation may yield large variances for coefficients due to issues with instrument selection, resulting in statistically insignificant estimates (Tayebi et al., 2011). Therefore, the two-stage GMM method proposed by Arellano and Bond is suggested to address this issue. Arellano and Bond proposed the following differenced equation:

$$Y_{it} - Y_{it-1} = \alpha(Y_{it-1} - Y_{it-2}) + \beta(X_{it} - X_{it-1}) + (\varepsilon_{it} - \varepsilon_{it-1}) \quad (9)$$

This means that, initially, differencing is performed to eliminate the fixed effects from the model. In the second stage, the residuals from the first stage are used to balance the variance-covariance matrix. In other words, this method creates variables known as instrumental variables to achieve consistent and unbiased estimates (Baltagi, 2005).

The consistency of the GMM estimator depends on the validity of the assumption of no serial correlation of the error terms and the instruments, which can be tested using several tests specified by Arellano and Bond (1991), Arellano and Bover (1991), and Blundell and Bond (1998). One of these tests is the Sargan test, which assesses the validity of the instruments. The Sargan test statistic (J-Statistic) follows a chi-squared distribution with degrees of freedom equal to the number of over-identifying restrictions (Alizadeh and Golkhandeh, 2015). Therefore, in this research, the Sargan test has been used to examine the consistency of the GMM estimator. For statistical and econometric analyses, the software EViews 10 has been utilized.

4- Results

Due to the possibility of spurious estimates with non-stationary variables, relying on the results of such estimates can lead to misleading conclusions (Baltagi, 2005). Therefore, before using these data, the stationarity of the variables is examined. In this regard, the Im, Pesaran, and Shin (2003) (IPS) test has been employed. The results of the stationarity test for the variables are presented in Table (1):

Table 1. Results of the Unit Root Test (IPS Test)

Variable	Prob	Critical Values
TFP_{it}	0.117	-1.18
K_{it}	0.56	0.17
$BRAN_{it}$	0.000	-5.25
LAB_{it}	0.000	-8.32
ROA_{t}	0.75	0.7

As shown in the results of Table (1), none of the variables are stationary at level. Therefore, considering that all variables in the study are non-stationary, it must be noted that estimating the model in this case may lead to spurious regression. To avoid reliance on spurious regression, the cointegration test is employed. The concept of cointegration implies the existence of a long-term equilibrium relationship that the economic system moves toward over time (Nofrasti, 2012). Thus, if the variables in the model are non-stationary but cointegration exists among them, the results obtained from the model estimation will be reliable. In this paper, the Kao (1999) test is used to examine cointegration in the employed models. In this test, the null hypothesis states that there is no cointegration, while the alternative hypothesis posits the existence of cointegration among the model variables. The results of the Kao cointegration test using the ADF statistic for the estimated model are presented in Table (2):

Table 2. Results of the Cointegration Test (Kao Test)

Prob	t	Variable
0.001	-3.101	ADF

Based on the results in Table (2), the null hypothesis of no cointegration among the variables is rejected, and the alternative hypothesis is accepted. Accordingly, the existence of a cointegration relationship among the research variables is confirmed. After confirming the presence of cointegration among the model variables, the model can be estimated without concern for the issue of spurious regression. As previously mentioned, the proposed model in this research is dynamic, and conventional panel data methods, due to their consideration of fixed effects, cannot resolve the issue of correlation of cross-sectional effects with explanatory variables. Therefore, a dynamic panel data model, which

accounts for the dynamic adjustment effects of the dependent variable and is preferred over other estimation methods, has been utilized. The results of the estimation of the coefficients of the model variables are presented in Table(3):

Table 3. Results of Coefficient Estimation of Model Variables using GMM Method

Variable	Prob	coefficient
TFP(-1)	0.26	0.21
LAB_{it}	0.01	0.001
K_{it}	0.09	0.43
$BRAN_{it}$	0.11	-0.02
ROA_{it}	0.09	0.84
Sarjent test	5.68(0.98)	

The results of the coefficient estimation test indicate that all variables, except for last year's productivity and the number of branches, are significant at the 90% and 99% confidence levels. The justification for the obtained coefficients will be provided in the next section. Following the estimation of the model coefficients, the Sargan test was used to examine the validity of the instrumental variables, and the Arellano-Bond statistic was employed to determine the autocorrelation of the disturbance terms. The results of the Sargan test are reported in Table.(3)

Based on the results, it is observed that the Sargan test statistic suggests the failure to reject the null hypothesis, indicating the validity of the defined instrumental variables. Therefore, the model does not require any additional instrumental variables. In other words, there is no correlation between the defined instrumental variables and the fixed or individual effects of the banks. Next, we will analyze the results obtained from the research:

5- Conclusion

This research utilized the generalized method of moments to examine the factors affecting the productivity of a selected group of banks in Iran from 2010 to 2017. Based on the obtained results, the impact of the productivity variable with a one-period lag and the number of branches in the examined group is statistically insignificant. On the other hand, the effects of labor, capital adequacy, and return on assets are statistically positive and significant. The justification for the significant coefficients is discussed below:

According to the research findings, labor (LAB) has a positive and significant impact on enhancing productivity in banks. It can be argued that considering resource limitations and the unlimited nature of human resources, population growth, and competition in the global economy, improving productivity is not just an option but a necessity. Economic entities must be able to cultivate knowledge and expertise regarding productivity among their managers and employees. Employees with adequate knowledge and expertise will perform their assigned tasks correctly, which itself signifies productivity; therefore, attracting and employing qualified human resources will enhance productivity.

Additionally, the results indicate that the impact of capital adequacy (K) on productivity is positive and significant. Capital serves as a link between inputs and human resources, thereby completing the production process and enhancing productivity. With the advancement of financial markets, capital has also become more complex. The effective use of capital, such as machinery and tools, plays a significant role in production growth and productivity enhancement. Capital accumulation also increases labor productivity; thus, the positive impact of effective capital utilization on enhancing productivity is undeniable. The results support the effective use of this input in the banking processes of the selected research group.

The impact of return on assets (ROA) on productivity is also found to be positive and significant. Researchers regularly differentiate return on assets into other ratios to obtain information regarding the profitability of companies. Return on assets is beneficial for current profitability and provides insights into the strategies of economic entities. In fact, this indicator is useful for expressing changes in the utilization of a company's assets towards achieving superior operational performance (Naseri et al.,

2018). Therefore, the positive relationship between return on assets and productivity enhancement is confirmed.

Based on the obtained results, the following recommendations are proposed to improve productivity levels:

- Banking sector managers should consider that organizing the workforce in banks, in addition to taking other characteristics into account, should be based on knowledge and expertise as one of the fundamental principles in selecting individuals. To this end, establishing a merit-based human resources system aimed at attracting qualified labor will have a significant impact on enhancing productivity.
- Banking sector managers should be aware that increasing the number of bank branches does not necessarily mean improving and enhancing productivity.
- Return on assets is one of the elements of profitability and, consequently, banking productivity. Therefore, based on the trend of this variable, information regarding the level of productivity in banks can be obtained, and if necessary, mitigating strategies or essential actions can be taken.

References

Ahmed, J.U, (2014), Productivity Analysis of Rural Banks in India: A Case of Meghalaya Rural Bank, The NEHU Journal, Vol XII, No. 1, pp. 53-76.

Akinkunmi, M, 2017. "Regulatory Impact of Bank Performance in Nigeria: Application of Stochastic Frontier Analysis," Applied Economics and Finance, Redfame publishing, vol. 4(4), pages 32-43.

Alhassan, A.L. & Biekpe, N. (2016). Explaining Bank Productivity in Ghana, Managerial and Das, Manoj Kumar and Patra, Subhamitra, Productivity and Efficiency of Public Sector Banks in India after the Global Financial Crisis (December 14, 2016). The IUP Journal of Bank Management, Vol. XV, No. 2, May 2016, pp. 50-62. Decision Economics, 37(8), pp 513-584.

Alirezaei, M. R., & Rajabi, M. (2017). Calculation of the balance index with a combined approach of DEA and BSC and its effect on productivity growth: A case study of a specialized bank branch. International Journal of Industrial Engineering and Production Management, 1(28), 54-44.

Alizadeh, M., & Golkhandan, A. (2015). Testing the Leviathan hypothesis for the Iranian economy using the generalized method of moments (GMM). Journal of Applied Economic Studies, 4(4), 141-166.

Al-Khasawneh.J.L, Essaddam.N, Hussain.T, (2020), Total Productivity and Cost Efficiency Dynamics of US Merging Banks: A Non-Parametric Bootstrapped Analysis of the Fifth Merger Wave, Quarterly Review of Economics and Finance, doi: https://doi.org/10. 1016/j.qref.2020.02.002.

Apergis, N. Polemis, M. L. (2016). Competition and efficiency in the MENA banking region: a non-structural DEA approach. Applied Economics, 48(54), 5276-5291.

Baltagi.B H, (2005) “Econometric Analysis of Panel Data", John Wiley & Sons Ltd, Third edition.

Bank Markazi J. A. (2018). Productivity in the Iranian economy. Economic Deputy, Economic Accounts Department.

Chen, Z. Wanke, P. Tsionas, M. G. (2018). Assessing the strategic fit of potential M&As in Chinese banking: A novel Bayesian stochastic frontier approach. Economic Modelling, 73, 254-263.

Dezhpasand, F., Amini, A., & Ahmadikabir, A. (2019). Analysis of factors affecting total factor productivity: A case study of selected specialized and commercial banks in Iran. Journal of Financial Economics, 13(49), 153-182.

Faghiljou, H., & Kalantari, A. (2019). Examining the performance of the Iranian banking system with a focus on the Malmquist-Leonberger multi-dimensional productivity index. Journal of Monetary and Banking Research, 12(40), 299-342.

Fathi, Z. (2011). Economic jihad and productivity increase. Research and Risk Control Department, Bank Sepah.

Fazl Yazdi, A., & Moeinoddin, M. (2016). Measuring efficiency and productivity of commercial banks in Iran using a combined TOPSIS fuzzy model, data envelopment analysis, and Malmquist productivity index. Strategic Management, 22(63), 111-85.

Jreisat, A., Hassan, H. and Shankar, S. (2018), "Determinants of the Productivity Change for the Banking Sector in Egypt", Kensinger, J. (Ed.) Global Tensions in Financial Markets (Research in Finance, Vol. 34), Emerald Publishing Limited, pp. 89-116.

Kao, C; Liu, S. (2014). Multi-period efficiency measurement in data envelopment analysis: The case of Taiwanese commercial banks, The International Journal of Management Science, Omega 47(2014)90–98.

María Concepción Pérez. M.C, Gómez-García. J, (2019) Goodness of governance effect on European banking efficiency, International Review of Economics and Finance (2019), doi: 10.1016/j.iref.2019.05.016

Movahed, A. B., Aliahmadi, A., Parsanejad, M., & Nozari, H. (2023). A systematic review of collaboration in supply chain 4.0 with meta-synthesis method. Supply Chain Analytics, 4, 100052.

Naseri, I., Abasi Fard, M., Jamshidi, A., & Abdi Hanjani, A. (2018). Investigating the impact of policies of Bank Melli Iran on increasing the return on assets index in that bank with a focus on resistance economy. Journal of Investment Knowledge, 7(28), 127-139.

Nofrasti, M. (1999). Unit root and cointegration in econometrics. Rasa Cultural Services Institute Publishing.

Nozari, H., Abdi, H., Szmelter-Jarosz, A., & Motevalli, S. H. (2024). Design of dual-channel supply chain network based on the internet of things under uncertainty. Mathematical and Computational Applications, 29(6).

Ranjabari, R., & Bagherzadeh, M. (2014). Ranking branches of Agricultural Bank of Tabriz based on human resource productivity and its impact on branch performance. Productivity Management, 8(31), 157-141.

Roghanian. P, Rasli. A, Gheysari. H, (2012), Productivity Through Effectiveness and Efficiency in the Banking Industry, The 2012 International Conference on Asia Pacific Business Innovation and Technology Management, Procedia - Social and Behavioral Sciences 40 (2012) 550 – 556.

Shahbainajad, V., Shahbainajad, H., & Sistani Badoei, Y. (2015). Measuring efficiency and comparing the productivity growth of branches of Bank Melli Iran in Kerman province using data envelopment analysis. Journal of Financial and Economic Policies, 3(12), 105-124.

Taheri, S. (2018). Productivity and its analysis in organizations (Comprehensive Productivity Management). Hestan Publishing.

Vafaee, A. R., Khodadad Kashi, F., & Shayegan, B. (2017). Measuring the productivity of irrigated barley production in Iran (Master's thesis). Payame Noor University, Tehran West Unit.

Yazdan Shenas, M., & Shojaei, M. H. (2016). Identifying and explaining the model of factors affecting knowledge productivity: A study in the branches of Bank Melli in Qom province. Productivity Management, 10(37), 70-51.