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Analysis of the Effect of EXIM Bank Efficiency on Non-Oil Export

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ABSTRACT

Banks are considered as vital circulatory system of finance and financial institutions that collect assets from various sources and allocate them to sectors that need market liquidity. Hence, banks are the vital arteries of any country. To evaluate the efficiency of the Export Development Bank of Iran, the cost efficiency of different branches was evaluated using estimation of Stochastic Frontier Model (SFA). Various inputs were fitted in the model and finally non-operating and operating incomes, as outputs, and overdue loan, default and Exim Bank capital, as bank's inputs, were identified. Accordingly, 27 branches of the Export Development Bank of Iran with continuous activity over the past three years were selected as a sample and their monthly cost efficiency was estimated. In the second step, the cost-effectiveness form of the bank was selected. The most common forms of Stochastic Frontier Model (including Cobb Douglass and Translog) were estimated using Frontier 4 software and the optimal form of the cost efficiency function was selected using statistical tests. Research results show that the nominal exchange rate and oil prices have a negative effect on gross national product and the bank's cost efficiency has a positive effect on non-oil exports. According to the research results, the bank's cost efficiency has increased in the period under review. It is suggested that in the medium term, the Export Development Bank prioritizes the closure of loss-making branches, increasing the bank's capital, attracting deposits, and reducing fixed assets and operating costs to improve the bank's cost efficiency.

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1- Introduction

In the present era, banking is one of the most important sectors of the economy, which has led to the expansion of markets and the growth and prosperity of economies in organizing and directing receipts and payments, facilitating trade and commerce. Banks can play a very constructive role in the economy by equipping savings and allocating them to various businesses. Export Development Bank of Iran, as the only Exim Bank of the country, can increase its efficiency by paying low-cost loans to export companies and providing the required working capital, as well as financing investment projects and development projects to increase export capacity. and their competitiveness in global markets will help a lot.

Putting emphasis on the development of non-oil exports as an important strategy is one of the ways to achieve continuous economic growth, which has always been emphasized as one of the central strategies of our country's economy. This policy, in addition to taking the country's economy out of the mono-product mode, leads to improving the balance of foreign exchange payments and increasing the strength and comparative advantage of our country in global markets. Paying attention only to the domestic market (import substitution policy) and lack of motivation for global marketing (export development) due to the support of inefficient domestic industries are the main factors limiting non-oil exports in recent years. Allocation of credit lines to foreign buyers is considered one of the most effective ways to finance exports and increase non-oil exports of countries. These types of loans are provided to foreign buyers to buy consumer goods or capital of the country. Given the easy repayment terms of such loans, the allocation of these credits increases the incentive for foreign buyers to purchase domestic products.

While bank functions can be complex and various, a bank is operationally defined as an institute whose current actions are mainly limited to giving loans to and taking deposits from people. It also

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plays an important role in the allocation of economic capital. A financial system with a developed level of efficiency can considerably facilitate allocation of appropriate sources to household consumptions as well as appropriate physical capital to productive sections in society. Thus, it is highly expected that efficient and profitable banks pave the way for the construction of an influencing financial system. In other words, the efficiency of the banks can lead to economic growth and development in their home country. The potential of banks to hold a highly efficient function determines their sustainability. In Iran, the banking industry plays a pivotal role in providing financial resources due to the lack of a capital market. That is why any shortage in the structure and function of banks might have an adverse effect on other sections. Thus, gaining deep insights into the policies of the banks in Iran seems essential (Tarkhani, Nazari & Niloofar, 2020).

The banking industry is one of the most important sectors in any economic system, because financial development and in particular the banking system lead to economic growth. The role of the banking system in financing the economy requires that the industry operate efficiently and effectively. The efficiency of the banking system means that it is able to provide services that lead to financing at a lower cost. Efficiency is an important concept in economics that represents a measure of success in resource allocation. In general, due to differences in equipment and allocation of resources, various restrictions in laws and regulations (ceiling of short-term and long-term facilities, etc.) and the cost of contracts between banks and the public (fees) cause differences in efficiency and performance of various banks because with the help of the efficiency appraisal process, we will be able to obtain useful information on how to do things effectively in the direction of the set goals (Amiri, 2018).

The mission of Exim Bank is to help exporters to meet government-supported competition from other countries and to correct market imperfections so that commercial export financing can

take place. The bank considers assistance in the export financing of goods and services when there is a reasonable assurance of repayment (OECD, 2010). Export Development Bank of Iran (EDBI) and other financial systems have been investing a vast amount of money in countries around the world that are still struggling with crisis, loss and bankruptcy the occurrence of negative shocks, especially during the epidemic of financial problems in banks, leading to a decline in exports by companies that export their products to global markets (Amiti & Weinstein, 2011; Paravisini, Septier, Moretton, Nigay, Arvisenet, Guichard & Dacremont, 2014; Del Prete & Federico, 2014).

Decreasing the exchange rate, which in turn reduces the value of foreign exchange cash assets and creates the risk of exchange rate fluctuations, on the other hand reduces the export earnings for a customer receiving the facility, reduces his expected income and thus reduces the repayment power and thus Credit risk is created. On the other hand, this will reduce the inflow of funds to the bank and create liquidity risk. In this case, the existence of one of the risks causes the emergence and strengthening of other risks and the set of risks affects the profitability and efficiency of the bank (Sarmiento, M, & Galan, 2017).

Amiri (2018) in a study entitled Evaluating the Efficiency of Selected Banks in Iran and its Relationship with Intra bank and Macroeconomic Variables showed that, on average, the efficiency of state-owned banks is 38%, the efficiency of private banks is 31% and the efficiency of privatized state-owned banks is 33%. According to the research results, the uncertainty of exchange rate fluctuations and inflation has a negative effect on the efficiency of Iranian banks. Exchange rate fluctuations also have a negative and significant relationship with the efficiency of Iranian banks. Ramazanian, yakideh & Akhavan Deilami (2019) in a study entitled Banking Management Efficiency Using DEA technique showed that collective network models have a lower number of efficiency units compared to

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the collective model they are simple. In addition, the efficiency obtained in the collective network model compared to the collective model Simple provides managers with a more accurate value that can identify the inefficiency of each Eliminate its weaknesses. Vahabi, Baradaran, Kazemzadeh & Rastegar (2021) conducted a three-level study evaluating the efficiency of bank branches using the Bootstrap Envelopment Analysis method. the results of this study show that at the third stage (profitability efficiency), due to large volume of non-performing loans (which are considered as undesirable inputs) or due to low volume of interest received on facilities and/ Or for both reasons, the efficiency of branches under review is lower than the other two stages. Also, none of the studied branches have been able to be efficient in all three stages. Furthermore, by comparing overall efficiency scores and modified overall efficiency scores, it can be seen that by modifying overall performance scores obtained from data envelopment analysis method, the overall efficiency of all branches is examined at a lower level. It should be noted that efficient branches are those whose efficiency is equal to one in terms of standard data envelopment analysis method, and if a branch with the highest modified efficiency is considered as an efficient branch, it means that bootstrap method is accepted as a method for ranking branches in terms of performance, while bootstrap method is not a valid method for ranking and only corrects the bias of standard data envelopment analysis method results.

According to European Central Bank (ECB, 2010), bank performance is described as the bank's capacity to generate sustainable profits. Bikker (2010) indicated the main drivers of bank performance as costs, efficiency, profits and market structure. Sherman and Gold (1985) conducted the first study of banking units using data envelopment analysis on 14 branches of US savings banks. The results of the calculation of production efficiency showed that only 6 branches had 100 efficiency (42% of the sample) and the reasons for inefficiency of other branches were poor management, size of branches, number of employees and operating costs.

Nowadays, due to liberalization of global trade, instability of foreign exchange income from oil exports, recent recession in global markets, the tendency to non- oil export development is doubled. Some export facilitations such as banks, are one of the most important factors in export development area for each country. In these situations, lack of an accurate (proper) financing infrastructure is an obstacle of trade. Limited access to financing resources and high costs, lack of insurances or guarantees, potentially have deterrent effect on trade and export, especially small and medium companies (SMEs), so the supporting and facilitating institutions to facilitate foreign trade are necessary. In such a situation, the existence of an efficiency evaluation system and using the result to improve future performance, which makes balance between risks and profits, is necessary.

Exim Bank of Iran is a governmental financial institution that is responsible for financing exports and export activities of Iranian companies. In general, Exim Bank provides financial and non-financial services in the domestic and international market to the country's export companies. There are more than 112 Exim Banks in the world, which are mainly governmental institutions and their main task is to develop the export of their national products in today's competitive world markets. Exim Banks are not competitors of the private sector. The risk of providing services to the private sector in that part of the ballast or the private sector is not able to meet the needs of that part of the market, so more than 70% of the world's Exim Bank customers are small and medium-sized businesses SMEs because businesses Small and medium-sized enterprises do not have sufficient resources and ability to enter international markets, and Exim Banks help to develop employment in their country by financing these industries.

Given the essential role of the banking system in the economies of countries, the government has always considered the efficiency of the banking industry and having efficient networks of

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branches is one of the main strategies in the strategy of efficiency improvement programs at the level of an Iranian export bank. Accordingly, the present study examined the cost-effectiveness of 27 branches of the Export Development Bank of Iran through stochastic border analysis. It is oil. Finally, the effect of bank cost efficiency on exports of non-oil products was estimated. After estimating the cost efficiency of branches, the effect of the average cost efficiency of branches (as bank cost efficiency) on non-oil exports was investigated.

The contribution of this research is in increasing the use of the findings of the efficiency model of Exim Bank in modeling macroeconomics in the country. This article shows which variables play a vital role in bank efficiency that indirectly affect non-oil exports. So far, no research has been done with this title, which is in fact an innovation of this research.

2- Theory of Efficiency by Parametric and Nonparametric Models

Seven criteria for evaluating firm performance are effectiveness, efficiency, productivity, quality, profitability and Profitability, quality of working life and creativity and innovation. The ratio of the amount of resources that are projected to achieve goals, objectives and activities Be used in proportion to the amount of resources actually used between productivity and the ratio or relationship between The amount of output produced by the firm using a certain amount of inputs is called productivity. Thus, improving the level of productivity is the result of producing more output using a fixed amount of input or producing a fixed amount of output using less input.

Usually, the purpose of examining productivity is to compare the conditions of a firm in several periods. In one or more periods, the firm uses less input to produce a certain amount of residue unless otherwise specified, that is, the production of the maximum amount of output with a certain amount of input is specified. This definition

is also related to the concept of efficiency, and therefore the firm that invests the least amount, by producing a certain amount of output and assuming the stability of other conditions, is considered the most efficient enterprise (Amiryusefi & Hafezi, 2006).

Bank efficiency studies are abundant by now. Nevertheless, Exim Bank efficiency and effective variables in their efficiency have not been studied yet. Besides, nobody research the result of efficiency this kind of banks in economy in spite of the fact that Exim Bank establish to operate government's macroeconomic aims in each country specially in export portion. Nevertheless, we have selected parametric model to assess Exim Bank efficiency model according to literature review of parametric and non-parametric models. Farrell (1957) suggests a non-parametric approach to measure technical efficiency by a linear programming method designated as Data Envelopment Analysis (DEA).Though widely used, DEA suffers numerous shortcomings such as sensitivity to random deviations, outliers, and data errors. Emrouznejad and Yang state that the banking field is the second application field that uses the DEA methodology in and Kaffash and Marra review DEA methods and its applications in financial services (Kaffash & Marra, 2016).

In the DEA method, introduced by Charens, Cooper, and Rhodes (CCR) in 1978, an efficient boundary curve is first created through a series of points determined by linear programming, and then characterized by an optimization process. Where the firm is located at this boundary, eventually the for-profit and non-for-profit firms are separated from each other. The most important advantage of this method is that it does not need to impose any specific subordinate form on the data and therefore due to this flexibility, it has gained a great reputation among researchers. Nevertheless, the calculated boundary function considers the existence of efficient boundary factors to be due to the inefficiency of the units and places it as inefficient - then Bunker, Charans, and Cooper in 1984 removed the assumption of constant relative-to-scale returns from this method.

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Therefore, this method is becoming more and more important (Hosseini & Souri, 2007).

Three methods of Stochastic Frontier Analysis (SFA), Distribution Free Analysis (DFA) and Thick Frontier Analysis (TFA) are different types of parametric methods. The differences in the functional form as well as the distribution of the error sentence in these three methods will make them different from each other (Ilieva, 2003). This method is a subordinate form and an error sentence Considers ink for production, cost or profit. One component including error, random error

Bilateral has a normal distribution with normal characteristics. This means that if the firm's performance is less than border production, part of it is due to lack of technical efficiency and the other part is due to accidental factor (Coelli, Prasada & Rao, 1998). The Distribution Free Analysis method, developed by Schmidt and Sickles (1984) and Berger (1993), defines a definite derivative form for the cost-benefit boundary and assumes that random error statements of the normal distribution with mean zero and variance They follow certain. Nevertheless, it does not impose any kind of distributive assumption on one-way error statements (inefficiencies). Berger & Humphrey (1997) The Thick Frontier Analysis (TFA) method assumes a definite form of subordination, but none assumes a distribution for inefficiencies or random errors (Berger & Humphrey, 1997).

Since the introduction of the Stochastic Frontier Analysis in 1977, considerable research has been conducted. By Battese & Coelli (1992), in order to expand the application of the basic frontier production model. Most Frontier Production Models do not explicitly form a pattern for the effects of inefficiency. Practical articles that explain the effects of inefficiency.

Aigner, Lovell & Schmidt (1977), Meeusen & Broeck (1977) proposed a parametric approach to measure technical efficiency:

Stochastic Frontier Analysis (SFA). In the field of estimating the efficiency of the banking industry, a number of studies have been conducted outside and inside Iran, including the studies of Srairi, (2009), Lensink, Meesters & Naaborg (2008), Staikouras, Mamatzakis, Koutsomanoli & Filippaki (2008), Fu & Heffernan (2007), Ahmad Mokhtar et al. (2006), Coelli, Prasada Rao & Battese (2000).

Sufian, Kamarudin & Nassir (2016) measured the Malaysian banking sector with a two-stage approach. The results show that the efficiency of the Malaysian banking sector has increased. Cost, allocation and technical efficiency in conventional and partner banks in Turkey. Batir, Volkman & Gungor (2017) investigated the cost, allocation and technical efficiency of conventional and joint venture banks in Turkey using the Data Envelopment Analysis (DEA) method. The results show that the efficiency of partner banks is higher than the efficiency of conventional banks.

Arabmazar, Varahrami & Hosseini (2019) in a study entitled evaluating the efficiency of banks using the DEA method uses a one-step production model, examining the efficiency of 18 banks in Iran, concluded that except for three banks, other banks performed less than the efficiency level, the efficiency of some banks is very poor and the banks that have a higher ratio of overdue receivables are mostly lower efficiency.(Arab Mazar et al, 2019).

Vahabi et al. (2021) conducted a three-level study evaluating the efficiency of bank branches using the Bootstrap Envelopment Analysis method. the results of this study show that at the third stage ("profitability efficiency"), due to large volume of non-performing loans (which are considered as undesirable inputs) or due to low volume of interest received on facilities and/ Or for both reasons, the efficiency of branches under review is lower than the other two stages. Also, none of the studied branches have been able to be efficient in all three stages. Furthermore, by comparing overall efficiency scores and modified overall efficiency scores, it can be

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seen that by modifying overall performance scores obtained from data envelopment analysis method, the overall efficiency of all branches is examined at a lower level. It should be noted that efficient branches are those whose efficiency is equal to one in terms of standard data envelopment analysis method, and if a branch with the highest modified efficiency is considered as an efficient branch, it means that bootstrap method is accepted as a method for ranking branches in terms of performance, while bootstrap method is not a valid method for ranking and only corrects the bias of standard data envelopment analysis method results.

Tabel 1. presents a number of efficiency studies
Source: Literature review

Author (publication date)	Inputs	Outputs
Aggelopoulos, Georgopoulos & Siriopoulos (2010)	Personnel expenses, Operational expenses, Loan loss impairments	Net interest income, Non-interest (fee) income (t)
Athanassopoulos (1997) 68 branches of a Greek commercial bank	number of employees, number of ATMs, number of computers	number of deposit accounts, number of credit and debit transactions,
Giokas (2008a)	personnel expenses, other operating expenses	value of deposits and loans, fee, income
Giokas (2008b)44 branches of a Greek commercial	personnel expenses, other operating expenses	value of deposits and loans , fee, income
Oral & Yolalan (1990)	personnel expenses, interest expenses, depreciation	interest income, fee income
Parkan (1987)	number of employees, other operating expenses , number of terminals	number of credit and debit transactions, number of loan applications
Vassiloglou & Giokas (1990)	number of employees, number of computers, operational costs	number of credit and debit transactions
Wu, Yang & Liang (2006)	number of employees, operational expenses	value of deposits and loans, fee income

Barnaba Chol, Kalunda Nthambib & Kamauc (2017) in a study entitled Ownership Structure, Bank Stability and the Financial efficiency of Commercial Banks in South Sudan concluded there was a statistically significant moderating effect of ownership structure on the financial efficiency of commercial banks in South Sudan. This

study recommends that the government should adopt better measures to safeguard public-owned commercial banks to improve their efficiency and performance.

Ndoka, Islami & Shimaand (2017) in their research on the effect of liquidity risk management on the efficiency of Albanian tread Banks (2005-2015) provided a contribution to the identification of liquidity risk factors that affect more the profitability of the Albania Banks and the finding of a scientific solution in order to manage this risk in a more efficient way. The recommendations derived from this study will help young researchers of academic area and professional field. In addition, this paper will create new discussions on risk management instruments used in the Albanian banking system.

3- Methodology

The following steps have been taken in the research for fulfilling the research objectives:

In the first step, in order to evaluate bank's efficiency, the cost efficiency of various branches was measured using Stochastic Frontier Model Function. Accordingly, 27 branches (Branches: Keshavarz Boulevard (Tehran), Argentina (Tehran), Tajrish (Tehran), Central Branch (Tehran), Mirdamad (Tehran), Mashhad, Bojnourd, Arak, Ardabil, Urmia, Isfahan, Rasht, Tabriz, Shiraz, Bandar Abbas, Kish, Qeshm, Zahedan, Bushehr, Ahvaz, Chabahar, Qazvin, Zanjan, Sanandaj, Sari, Qom and Karaj) with continuous activity during the past three years were selected as sample and their monthly efficiency was estimated. For measuring Exim Bank efficiency, bank's expenses were considered as a function of input and output variables and then estimated using Frontier 4 software. Various inputs were fitted in the model and finally non-operating and operating incomes, as outputs, and overdue loan, default and Exim Bank capital, as bank's inputs, were identified.

When the function and its variables were determined, in the

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second step, the form of bank's cost function was selected. The most common forms of Stochastic Frontier Model Function (including Cobb Douglass and Translog Functions) were estimated using Frontier 4 and the optimal form of cost function was selected using statistical tests. After choosing the form of cost function, since the software offers two estimations for the function, attempts were made to select the optimal estimation between MLE and OLS. Next, variability of the model's inefficiency in terms of tested time and inefficiency (efficiency) of various branches were measured. In the third step, the overall efficiency of the bank was calculated using the function and the effect of the Export Development Bank's efficiency on non-oil export in a 36 month period (2016-2019) was determined using an econometric model and Eviews software.

4- Bank efficiency using SFA model

As mentioned above, econometric estimation of cost function requires selection of function form. The model was estimated in Cob Douglass and Translog models and research model was selected. In addition, the model was estimated with different inputs and outputs. Only the final function form is entered here. General form of Cob Douglass and Translog functions are respectively as follows:

$$\ln(TC) = \alpha_0 + \sum_{i=1}^{2} \alpha_i \ln(Q_i) + \sum_{j=1}^{2} \beta_j \ln(P_j) + u_{it} + v_{it}, \quad (1)$$

$$i = 1, 2, ..., t = 1, 2, ..$$

$$\ln(TC) = \alpha_0 + \sum_{i=1}^{2} \alpha_i \ln(Q_i) + \sum_{j=1}^{2} \beta_j \ln(P_J) + \sum_{i=1}^{2} \alpha_{ii} (\ln Q_i)^2 + \sum_{i=1}^{2} \beta_{jj} (\ln P_j)^2 + \sum_{i=1}^{2} \sum_{j=1}^{2} \gamma_{ij} (\ln Q_i)(\ln P_J) + u_{it} + \upsilon_{it}$$

$$, i = 1, 2, ..., t = 1, 2...,$$

TC_{it} is the total cost of i[th] bank, Q_{it} is output, P_{jit} is input price, U_{it} is random error and U_{it} is cost inefficiency.

The following test can be used to select between Cob Douglass and Translog functions. If multiplication of all the coefficients of model variable squares by variable coefficients results is zero, Cob Douglass is preferred; otherwise, Translog will be selected.

$$\begin{cases} H_0 : \beta_{ii} = \beta_{jj} = \beta_{ij} = 0 \\ H_1 : \beta_{ii} \neq \beta_{jj} \neq \beta_{ij} \neq 0 \end{cases} \quad (2)$$

Hypotheses related to Stochastic Frontier Model were tested using the following likelihood test:

$$\lambda = -2\{\log[L(H_0)/L(H_1)]\} = -2\{\log L(H_0) - \log L(H_1)\}$$ In which λ is the statistic of $L(H_0)$ and $L(H_1)$ MLE proportionate with the limits imposed by H_0 and H_1 hypotheses.

λ in limits terms has X^2 distribution with degree of freedom as for number of limits. If H_0 is true, the statistic of the above test will be smaller than the value of; X^2 otherwise, H_0 is rejected (**Tabel** 2).

Since log likelihood values for Cob Douglass and Translog functions are 138.8 and 102.8 respectively, thus:

$$\lambda = -2_*(138.8 - 102.8) = -2(36) = -72$$

Tabel 2. Hypothesis test
Source: Research calculations

Decision	Critical value	λ	Null hypothesis
H_0 confirmation	3.84	-80	H_0

Therefore, based on the results, since the value of λ is less than the critical amount of X^2 test, H_0 is confirmed and H_1 is rejected. In other words, Cob Douglass is preferred to Translog.

After model type selection, either Maximum Likelihood

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Estimation (MLE) or Ordinary least Squares (OLS) was to be selected.

Along with this purpose, we tested the following hypothesis:

(3) $$\begin{cases} H_0 : \gamma = 0 \\ H_1 : \gamma \neq 0 \end{cases}$$

λ of Cob Douglass model is 0.17, but t statistic of it shows that it is significant ($p<0.05$). Thus, it can be concluded that inefficiency parameter in the model is significant. Thus, MLE is preferred to OLS.

If in the estimated model η=0 and μ=0, i.e. inefficiency is a time-dependent variable, inefficiency distribution (U1) will be semi-normal.

In order to test the above hypothesis, such as function type selection hypothesis, the following likelihood test was used:

(4) $$\lambda = -2\{\log[L(H_0)/L(H_1)]\} = -2\{\log L(H_0) - \log L(H_1)]\}$$

In which λ is the statistic of $L(H_0)$ and $L(H_1)$ MLE proportionate with the limits imposed by H_0 and H_1 hypotheses.

λ n limits terms has X^2 distribution with degree of freedom as for number of limits. If H_0 is true, the statistic of the above test will be smaller than the value of X^2; otherwise, H_0 is rejected (**Tabel 3**).

In order words, the estimated model has a time-dependent inefficiency.

Finally, concerning the above tests, final form of the function is as follows:

H_0 and H_1 hypotheses will be as follows:

$$\begin{cases} H_0 : \mu = 0, \eta \neq 0 \rightarrow \log likelihood = 141.6 \\ H_1 : \mu \neq \eta \neq 0 \rightarrow \log likelihood = 138.8 \end{cases} \quad (5)$$

Tabel 3. Time-Dependent Inefficiency Hypothesis Test
Source: Research calculations

Decision	Critical value	λ	Null hypothesis
Acceptance	3.84	-5.6	H_0

Log of MLE under H_0 hypothesis is 95.31 and λ is as follows:

$\lambda = -2 \times (141.6 - 138.8) = -2$, table $\chi^2 \neq 3/84$

Since λ is an estimation of X^2 statistic of the second table, H_0 is accepted. In other words, the model has time-dependent inefficiency.

Finally, concerning the above tests, final form of the function is as follows:

$$\ln(TC) = \alpha_0 + \sum_{i=1}^{2} \alpha_i \ln(Q_i) + \sum_{j=1}^{2} \beta_j \ln(P_j) + u_{it} + v_{it} \quad (6)$$
$$, i = 1,2,...,t = 1,2,...$$

In which:

Outputs include:

Q_1: non-operating income,

Q_2: operating income,

Inputs include:

P_1: overdue loan,

P_2: default,

P_3: Exim Bank capital,

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Summary of model parameters estimation (**Tabel 4**):

Tabel 4. Parameter Estimation
Source: Research calculations

Variables		Model	
		Coefficient	**T- value**
C	α_0	10.93	10.75
Ln(Q_1)	α_1	-0.102	7.41
Ln(Q_2)	α_2	0.330	5.81
Ln(P_1)	α_3	0.047	4.54
Ln(P_2)	α_4	0.103	2.44
Ln(P_3)	α_5	0.343	5.45
Sigma		0.17	-
Log- likelihood		138.8	

Based on the results of final model, all model variables were significant ($p<0.05$). In addition, braches' capital was one of the main input variables of the model that shows the importance of this variable in different branches of Export Development Bank. Although the bank is a specialty bank in non-oil exports section and its main capital is provided by the government, the role of the government in this efficiency is undeniable.

5- Unit Root Test

In the earlier models, bank deposits variable was studied as one of the bank's inputs but its significance was not confirmed. The reason is the specialty structure of this bank that cannot absorb deposits.

According to the results of LLC, IPS, ADF tests (**Tabel 5**), in all variables except the exchange rate and the null hypothesis (the value of the significance level is less than 0.05) as a result of the above variables during the research period, at the level Have been stationarity and the nominal exchange rate variable has been mana with double differentiation. In econometric models, a single root test is performed before estimating the model:

Tabel 5. The results of the unit root
Source: Research calculations

Variable	Interrupt length	Test statistics ADF	Test statistics IPS	Test statistics LLC
Monthly Exchange Rate	1	34.43 (0.000)	-9.64 (0.000)	-6.32 (0.000)
Monthly GNP	0	126.60 (0.000)	-15.29 (0.000)	-11.70 (0.000)
Monthly Oil Price	0	168.75 (0.000)	-19.08 (0.000)	-20.53 (0.000)
Monthly Cost Efficiency of Export Development Bank	0	105.64	-10.21 (0.000)	-11.98 (0.000)

In connection with the generalized torque model, Sargan Testis used in order to select the appropriate instrumental variables. Sargan test statistic has a chi-square distribution with degrees of freedom equal to the number of excesses specified. According to the probability value of this statistic, it can be concluded that the instrumental variables used in the model have been properly selected and the hypothesis of zero validity of the instrumental variables is confirmed. Orlando and Bound's Test statistics were also used to determine the degree of autocorrelation of noise sentences. To determine the degree of autocorrelation of noise sentences, the results of the above test are reported in (**Tabel 6**).

Tabel 6. Results of Sargan test, Orlando, and Bound's Test
Source: Research calculations

Test	**Test statistics IPS**
Sargan	8.04 (0.33)
Autocorrelation rank 1	2.84 (0.000)
Autocorrelation rank 2	2.48 (0.000)

*. The numbers in parentheses indicate the significance of the coefficient.

6- Estimation of non-oil exports function:

After estimating the cost efficiency of branches, the effect of the

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average cost efficiency of branches (as bank efficiency) on non-oil exports was investigated. Along with this purpose, non-oil export was considered as a function of exchange rate, GNP, Oil Price and cost efficiency of Iranian Export Development Bank. The general form of the function is as follows (7):

$$Log\ EX = \alpha + \beta_1.Log\left(X_1\right) + \beta_2.Log\ \left(X_2\right) + \beta_3.Log\left(X_3\right) + \beta_4.Log\left(X_4\right) + U \quad (7)$$

In which:

X_1: Monthly exchange rate,

X_2: Monthly GNP,

X_3: Monthly Oil Price,

X_4: Monthly the average cost efficiency of branches (as bank cost efficiency) estimated in the previous section using Scholastic Frontier Function. U is model disturbance sentence.

Before model estimation, reliability of the model variables was confirmed using Dickey Fouler Test. When reliability of variables was confirmed, the model was estimated using ordinary minimum squares method and Eviews software. Model estimation using OLS method is as follows:

$$Log\ EX = \underset{(3.35)}{19.37} - \underset{(-3.14)}{4.56}Log\left(X\,1\right) + \underset{(3.33)}{0.77}\ Log\left(X\,2\right) - \underset{(-2.51)}{0.29}Log\left(X\,3\right) + \underset{(6.97)}{10.6}.Log\left(X\,4\right) \quad (8)$$

R^2 of the model is about 69%. That is 69% of the dependent variables can be explained by the independent ones.

t statistic related to all the independent variables of the model is significant ($p<0.05$). At 95% significance level the value of model t statistic is to be more than 1.96.

Model F statistic is 17.01 that shows that the total fitted model is significant.

Durbin–Watson statistic, according to the estimated results, is 1.96.If Durbin–Watson statistic is between 1.5 to 2.5, the hypothesis that there is no self-correlation in model errors can be accepted. Thus, independence of errors among model errors can be accepted.

X_1 variable coefficient is estimated to be -4.56. That is nominal exchange rate has a negative effect on non-oil exports and 1 unit increase in nominal exchange rate decreases non-oil export up to 4.56 units. discussed Theories in this regard have confirmed this also. Based on these theories, in developing countries, import has more impact on the economy rather than export. Therefore, in such items, relation between the exchange rate and export is reversed.

X_2 variable coefficient is 0.77. That is GDP has a positive direct effect on non-oil exports. One unit of increase in GNP results in 0.77 unit of increase in non-oil exports.

X_3 variable coefficient is -0.29. That is Oil price has a negative direct effect on non-oil exports. One unit of increase in Oil Price results in -0.29 unit of decrease in non-oil exports. This theory is according to Dutch disease in economy.

X_4 variable coefficient is 10.6. That is bank's Cost efficiency has a positive correlation with non-oil exports. In case of the effect of bank's efficiency on non-oil export it should be mentioned that the inputs related to bank's efficiency is in percentage and non-oil export data are in million dollars. When the Cost efficiency of all the branches of Export Development Bank increases one unit, non-oil export increases 10.6 units. Therefore, the efficiency of bank ranches played an effective role in non-oil exports in the period under study.

7- Conclusion

Based on the research findings, nine proposals have been presented to improve the Cost efficiency of Exim Bank and develop non-oil

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exports.

a) Increasing the bank's capital continuity over time: Increasing the bank's capital strengthens the bank's ability to finance export companies and creates a competitive advantage for export companies. With the increase of the bank's capital, the bank's financing power for the countries importing goods and services from Iran will increase.

b) Reduction and merger of loss-making branches that due to the situation and conditions, the branch is not able to cover its costs. With the reduction of loss branches, the Cost efficiency of Exim Bank increases.

c) Increasing the productivity of human and physical capital by holding effective training courses and revising the recruitment and employment of manpower in a traditional way and using scientific methods to attract talented, specialized, motivated and interested manpower, etc.

d) Although a slight decrease in the exchange rate of the rial against other currencies leads to an increase in the competitiveness of export goods and services,however, this advantage, through the occurrence of high domestic inflation, leads to an increase in the price of export goods and services and reduces the competitiveness of export products globally and against imported products. Therefore, the central bank should strictly avoid applying monetary policies that result in inflation in the economy.

e) Since the increase in the Cost efficiency of the Export Development Bank leads to more support from the Export Development Bank to exporters in providing the required financial resources, it is suggested that the management of the Export Development Bank prioritize increasing the Cost efficiency of the bank in the medium and long term planning.

f) Since the Cost efficiency of Exim Banks plays an important role in export development, the government can increase supportive

facilities by Exim Banks to improve non-oil exports.

g) The central bank should adopt policies in relation to large fluctuations in the nominal exchange rate to prevent shocks. The occurrence of shocks in the foreign exchange market and the increase in the nominal exchange rate leads to an increase in the general level of prices in the domestic economy and thus reduces the competitiveness of domestic products.

h) In order to increase cost efficiency, it is suggested that the Export Development Bank of Iran prioritize the reduction of fixed assets over a medium-term period.

References

Athanassopoulos, C., Auerbach, L. B., Burman, R. L., Caldwell, D. O., Church, E. D., Cohen, I., ... & LSND Collaboration. (1997). Evidence for nu_mu-> nu_e Neutrino Oscillations from LSND. *arXiv preprint nucl-ex/9709006*.

Aggelopoulos, E., Georgopoulos, A., & Siriopoulos, C. (2010, June). Comparative efficiency analysis of Greek bank branches in the light of the financial crisis. In *Proceedings of the 2010 Annual Meeting of the EEFS International Conference* (pp. 1-32).

Ahmad Mokhtar, H.S., Abdullah, N., & Al-Habshi, Syed M. (2006). Efficiency of Islamic banking in Malaysia: A stochastic frontier approach, *Journal of Economic Cooperation*, 27(2), 37-70.

Aigner, D., Lovell, C.A.K., & Schmidt, P. (1977). Formulation and Estimation of Stochastic Frontier Production Function Models. *Journal of econometrics*, 6, 21- 37.

Amiti, M., & Weinstein, D. E. (2011). Exports and financial shocks. *The Quarterly Journal of Economics*, *126*(4), 1841-1877.

Amiri, Hossen .(2018). Assessing the efficiency of selected banks in Iran and its relationship with intra-banking and macroeconomic variables .*Iranian Journal of Applied Economic Studies* ,7(26) ,89-114. doi: 10.22084/AES.2018.14331.2510 (in Persian)

Amir Yousefi, K., & Hafezi, B. (2006). Efficiency in Banking Industry A Case Study of Measuring Efficiency in Banking System in Isfahan Province. *Quarterly Journal of Economic Research and Policies, 14*(39), 27-57. Retrieved from http://qjerp.ir/article-1-289-en.html (in persian).

Athanasopoulos, A.(1997). Service quality and operating efficiency synergies for management control in the provision of financial services: evidence from Greek bank branches. *European Journal of Operational Research* ،98, 300 -313.

Arabmazar, Abas.,Varahrami, vida & Hosseini, Hussein .(2019). Evaluate the performance of the country's banks using network data envelopment analysis. *Quarterly Journal of Quantitative Economics (JQE)*, 15(2)1-22. 10.22055/jqe.2017.21388.1596 (in Persian).

Barnaba Chol, Bak., Kalunda Nthambib, Elizabeth & Kamauc, Joseph.(2017). Ownership Structure, Bank Stability and the Financial Performance of Commercial Banks in South Sudan Bak. *Integrated Journal of Business and Economics*, 7(15),1-13.

Batir, T.E., Volkman, D.A & Gungor, B. (2017). Determinants of Bank Efficiency in Turkey: Participation Banks Versus Conventional Banks. *Borsa Istanbul Review*, 17(2): 86-96.

Battese, G. E., Heshmati, A., & Hjalmarsson, L. (2000). Efficiency of labour use in the Swedish banking industry: A stochastic frontier approach. *Empirical Economics*, *25*(4), 623-640.

Berget, A. N., & Humphrey, D. B. (1991). The dominance of inefficiency over scale and product mix economics in banking [J]. *Journal of Monetary Economics*, *28*, 117-148.

Berger, A. N., & Mester, L. J. (1997). Inside the black box: What explains differences in the efficiencies of financial institutions?. *Journal of banking & finance*, *21*(7), 895-947.

Berger, A., & Humphrey, D. (1997). Efficiency of financial institutions: International survey and directions for future research. *European journal of operational research*, 98 (2), 175-212.

Bikker, J. A. (2010). Measuring performance of banks: an assessment. *Journal of Applied Business and Economics*, 11(4), 141-159.

Chor, D., & Manova, K. (2012). Off the cliff and back? Credit conditions and international trade during the global financial crisis. *Journal of international economics*, *87*(1), 117-133.

Coelli, Tim., Prasada Rao, D.S., & Battese, G.E. (1998). *An introduction to efficiency and productivity analysis*. Boston, Kluwer Academic Pub.

Del Prete, S., & Federico, S. (2014). Trade and finance: is there more than just'trade finance'? Evidence from matched bank-firm data. *Evidence from Matched Bank-Firm Data (January 24, 2014). Bank of Italy Temi di Discussione (Working Paper) No*, *948*.

Emrouznejad, A., & Yang, G. L. (2018). A survey and analysis of the first 40 years of scholarly literature in DEA: 1978–2016. *Socio-economic planning sciences*, *61*, 4-8.

Farrell, M. J. (1957). The Measurement of Productive Efficiency. *Journal of the Royal Statistical Society*, *120*(3), 253–290.

Fu, X., & Heffernan, Sh. (2007). Cost X-efficiency in China's banking sector. *China Economic Review*, *18*, 35-53.

Giokas, D. (2008a). Assessing the efficiency in operations of a large Greek bank branch network adopting different economic behaviors. *Economic Modeling* , *25*, 559-574.

Giokas, D. (2008b). Cost efficiency impact of bank branch characteristics and location: An illustrative application to Greek bank branches. *Managerial Finance* , *34*, 172-185.

Ilieva, I.S. (2003). Efficiency in the banking industry: *Evidence from Eastern Europe.* New York, Fordham University.

Kaffash, S.& Marra, M. (2016). Data envelopment analysis in financial services: A citations network analysis of banks, insurance companies and money market funds. *Annals of Operations Research*, *253*, 307–344.

Shahid Chamran University of Ahvaz
Quarterly Journal of Quantitative Economics
(former Economic Studies)

Lensink, R., Meesters, A., & Naaborg, I. (2008). Bank efficiency and foreign ownership: Do good institutions matter?. *Journal of Banking & Finance*, *32*(5), 834-844.

Manova, K.,S.-J.Wel, & Z. Zhang .(2015). Firm Exports and Multinational Activity Under Credit Constraints. *Review of Economics and Statistics*, *97*(3), 574–588.

Meeusen, W & J. Van den Broek .(1977). Efficiency Estimation from Cobb-Douglas Production Functions with Composite Errors. *International Economic Review* ,*18*, 435–44.

Mester, Loretta J. (1996). A study of bank efficiency taking into account risk- preferences. *Journal of banking and finance, 20*, 1025- 1045.

Ndoka, S., Islami, M., & Shima, J. (2017). The impact of liquidity risk management on the performance of Albanian Commercial Banks during the period 2005-2015. *International Journal of Social Sciences and Education Research*, 3(1),70-76.

OECD (2000). *Mergers in Financial Services*. Paris: OECD.

Oral, M & Yolalan, R.(1990). An empirical study on measuring operating efficiency and profitability of bank branches. *European Journal of Operational Research*, 46, 282-294.

Paravisini, L., Septier, C., Moretton, C., Nigay, H., Arvisenet, G., Guichard, E., & Dacremont, C. (2014). Caramel odor: Contribution of volatile compounds according to their odor qualities to caramel typicality. *Food Research International*, *57*, 79-88.

Parkan, C., (1987). Measuring the efficiency of service operations: an application to bank branches, *Engineering Costs and Production Economics*, *12*, 237-42.

Pitt, M. & Lee, L. (1981) The Measurement and Sources of Technical Efficiency in the Indonesian Weaving Industry. *Journal of Development Economics*, *9*, 43-64.

Ramazanian, Mohammad Rahim., yakideh, keykhosro & Akhavan Deilami, Lobat .(2019). Assessing the efficiency of bank management using DEA technique (case study of different branches of Tehran banks).

Productivity Management, *13*(49),123-144. doi: 10.30495/QJOPM .20 19. 666889. .(inPersian)

Sarmiento, M, & Galan, J. (2017). The influence of risk-taking on bank efficiency: Evidence from Colombia. *Emerging Markets Review Elsevier*, *32*(C), 52-73.

Sheldon, G. (1994). Economies, inefficiences and technical progress in swiss banking. In *The competitiveness of financial institutions and centres in Europe* (pp. 115-132). Springer, Dordrecht.

Sherman, H. D., & Gold, F. (1985). Bank branch operating efficiency: Evaluation with data envelopment analysis. *Journal of banking & finance*, *9*(2), 297-315.

Staikouras, C., Mamatzakis, E., & Koutsomanoli-Filippaki, A. (2008). Cost efficiency of the banking industry in the South Eastern European region. *Journal of International Financial Markets, Institutions and Money*, *18*(5), 483-497.

Sufian, F.; Kamarudin, F. & Nassir, A.M. (2016). Determinants of Efficiency in the Malaysian Banking Sector: Does Bank Origins Matter*?*. *Intellectual Economics*, 10(1), 38-54.

Tarkhani, Atieh., Nazari, Azim & Niloofar, Parisa .(2020). Investigating effective factors on the Efficiency of Iranian Banking Industry (Simar and Wilson's two-stage method).*Quarterly Journal of Quantitative Economics(JQE)* ,17(2).1-41. doi: 10.22055/jqe.2020.24855.1819 . (in Persian)

Tulken, H. (1993). On FDH efficiency analysis: Some methodological issues and applications to retail banking, courts, and urban transit. *Journal of Productivity Analysis*, 4, 179-210.

Vahabi ,Meysam, Baradaran Kazemzadeh, Reza & Rastegar ,Mohammad Ali. (2021). Bank branches efficiency evaluation: The three-stage bootstrap DEA approach. *Quarterly Journal of Quantitative Economics (JQE),* 18(3) 35-64. doi: 10.22055/JQE.2020.28071.2008 (in Persian).

Vassiloglou, M., Giokas, D. (1990). A study of the relative efficiency of bank branches: an application of DEA. *Journal of Operational Research Society*,41,591-597.

Weill, L.(2004). Measuring Cost Efficiency in European Banking: A Comparison of Frontier Techniques. *Journal of Productivity Analysis*,21, 133–152.

Wu, D. D., Yang, Z., & Liang, L. (2006). Using DEA-neural network approach to evaluate branch efficiency of a large Canadian bank. *Expert systems with applications*, *31*(1), 108-115.