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AN EMPIRICAL INVESTIGATION ON ECONOMIC EFFICIENCY OF AGRICULTURE BANKS: USING DEAP METHOD

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ABSTRACT

Agricultural loans have a direct effect on banks operational efficiency in agricultural sector. In addition, regulations and rules in the agricultural loan sector will play important role in the agricultural banks efficiency. This study tried to measure allocative efficiency, technical efficiency and economic efficiency and recommend some possible suggestions for those interested agricultural banking sector. The total assets of the banking sector in Iraq are estimated at about 2 billion dollars, but the percentage of these banks contribution to the gross domestic product does not exceed 8%, which is a low percentage, which reflects the limited role in economic activity. The research used method of Data Envelopment Analysis (DEA) to evaluate the variable and fixed economic efficiency for agricultural banks sector in Iraq. The data collection sources used in the current research is based on the data published in the annual reports. The results exposed that all means of efficiency declined in Turkish Agricultural Bank for the period 2015-2020. The results illustration that all efficiency averages and performance using DEA during 2015-2020 for Agricultural Cooperative Bank were high. Finally, we must also point out that all the tables refer to the VRS results with regard to further methodological improvement to measure efficiency in the agricultural banking sector.

Keywords: Economic Efficiency, Agricultural Banks, DEAP, Allocative Efficiency

INTRODUCTION

The agricultural loans quality will impact the bank operations cost (Chen, 2001). Therefore, agricultural loans have a direct effect on banks operational efficiency in agricultural sector. In addition, regulations and rules in the agricultural loan sector will play important role in the agricultural banks efficiency (Chen, 2001). Agricultural banks may respond to banking regulations which lead to changing practices of agricultural lending (Regmi, Featherstone, Cowley & Taylor, 2020). These changes in ranges and types of agricultural lending and agricultural loan services affect the success of the agricultural sector as a whole. Problem agricultural loans might occur many frequently in the bad economic conditions (Chen, 2001). According to Ellinger (2011) the agricultural banks has been faced problem in performance through financial crisis. As he mentioned there is a decline in return of assets in 2009. The agriculture sector has impact in some factors such as technology innovation and regularity change which contribute in change of structure of agriculture banking (Choi, Stefanou & Stokes, 2007). Financing has become one amongst the important determinants in determinable the sorts, sum and agricultural production quality of a rustic. Thus the agricultural development tempo might be accelerated through the adequate credit availability to the agriculture at the suitable time, at the correct place and through the agricultural banks (Sahoo, Dash & Rath, 2020). One of the most important issues which face agricultural banks in developing countries(Iraq) insistent increase in

lend default, wherefore several lending organization resort to group lending that is depend on joint liability model to decrease this issue (Ajah, Ofem & Bassey, 2020). The economic logic refers to efficiency makes banks more flexible to economic disturbance, thereby significantly and positively affecting growth (Novickytė & Droždz, 2018). On the other hand, the collapse of the financial system can be occurring by banks. In generally banks have a role essential in the economy of agricultural sector and households as well as for businesses (Řepková, 2015). Thus, this research tested the economic efficiency of agriculture banks in Iraq.

AGRICULTURAL BANKING SECTOR IN IRAQ

Agriculture was the essential foundation of the Iraqi economy, but it has deteriorated due to war, economic sanctions and political turmoil. The Agricultural Cooperative Bank (ACB) of Iraq was established in 1935 as a state-owned bank in charge of supporting the agricultural sector and various other activities (Al-Sahrawardee, 2015). Without a doubt, agricultural finance is considered the most important input used in agricultural production. The country depends on thousands of small farmers working in the agricultural sector. Agricultural banks form the basis of the banking system and consist of both public and private banks (Joghee, 2020). Although the Agricultural Bank is a very necessary institution by granting farmers medium and long-term loans, long-term loans remain of great relative importance (Al-Aqidi & Al-Saadi, 2013). The total assets of the banking sector in Iraq are estimated at about 2 billion dollars, but the percentage of these banks' contribution to the gross domestic product does not exceed 8%, which is a low percentage, which reflects the limited role in economic activity (Hussain, 2019).

LITERATURE REVIEW

In this study will focus about the previous studies in last four years. Majority of studies found that the efficiency economics of Agriculture banks very weak or unstable For example, Kundu & Banerjee (2021) through their research paper, they discussed the extent of efficiency between private and public banks in India. The study appeared the larger and older banks performed better in both the models. Sakouvogui, Shaik & Addey (2020) This research focus on the extreme issues in agricultural banks in USA using (DEA) method by presenting a cluster-adjusted DEA model. The finding of this paper proved the DEA application provides statistically better economic efficiency measures (Sahoo et al., 2020). The study used Garrett Scoring Techniques approach for estimate the grower difficulty in obtaining and agriculture credit repayment. The study found many farmers have financial problems because of unjustified interest high rate, farmers were heavily burdened with debts that leads to problems in the repayment of loans. In additionally more important problems that farmers faced in obtaining the institutional credit were the loan non-availability on the right time, procedures for obtaining credit. Another stydy done by Attipoe, Jianmin, Opoku-Kwanowaa & Ohene-Sefa (2020) That studied Technical Efficiency determinants of Production Cocoa in Ghana country using model Stochastic Frontier Analysis (SFA). They found that the gap of efficiency middle midst credit recipients and non-credit recipients is 0.09 (9%) confirming the significant effect of loans on farmers' efficiency. Link the agricultural growth indicators like income to efficiency and cocoa output, close monitoring showed that increasing growers accessibility to loan can achieve the economic efficiency between farmers and lead to decrease rate in poverty severity. Other studies such as Ajah, et al., (2020) this research explain loan mitigation default in Nigeria through a shared responsibility form. The result showed that business experience and family size were the key determinants of loan retardation. There was an obvious difference in amounts of loan return between joint and individual loan beneficiaries. According to study it was done by Chandio,

Jiang, Gessesse & Dunya (2019). examined the impact of farm area and agricultural credit on the economic efficiency in Sindh, Pakistan using Method of the random production limits function to test the survey data. The finding explains that credit and farm size impacted on the efficiency. Additionally, the study finding significant effect on farm size while size is greater and more important than flexibility was found on credit further, the average technical efficiency was 0.97. Therefore, agricultural credit considers one of the most important factors which effect on the technical efficiency. A study undertaken by Lawal, Olayanju, Ayeni & Olaniru (2019). Their studies focused on tested the impact of agricultural bank loans on agricultural output in Nigeria. This is to ensure that there is a causal relationship between the agriculture sector and bank credit. Statistical and standard tests proved there is no long-term relationship between the variables that was used in the study.

Similarly, Regmi, et al., (2020) explain the nature of the relationship between the big banks and the different agricultural banks and the extent of their impact on economic efficiency. The finding of the paper showed an increase in the size of financial incentives and reduced economic efficiency in agriculture banks. Sakouvogui (2019) his studies focused on clarification the impact of the financial crisis on the agricultural banks sector DEA efficiency measures. The results showed that the economic efficiency of agricultural banks was stable and efficient during the study period. Harimaya & Kagitani (2019) Evaluating efficiency of agricultural banks in Japan country. Appear the study finding there is obvious evidence of essential differences in the values of economic efficiency. On the other hand, the high dependence on the loans leads to lower level of efficiency. Novickytė & Droždz (2018) evaluating the efficiency in the banking Sector Lithuania using data envelopment analysis model. The findings of the research showed that best consequences are demonstrated by the local banks and group and the branches have higher economic efficiency than local banks and it achieved many of its goals. Chen, Matousek & Wanke (2018). The efficiency of Chinese bank during the global financial crisis using DEA model. The results reveal that the economic efficiency level of the agricultural banks Low and sub-ambitious.

ALLOCATIVE EFFICIENCY, ECONOMIC EFFICIENCY AND PRODUCTIVITY EFFICIENCY

Most of the studies on the efficiency of banks in the agricultural sector focus on Technical Efficiency (TE), which is only one component of Economic efficiency. However, allocative efficiency also requires the optimal allocation of resources. Technical efficiency is important but not essential (Zulfiqar, Shang, Nasrullah & Rizwanullah, 2020). One of the characteristics of economic efficiency is that they have similar results and comparable roots (Zerbe, 2019). Productive efficiency is concerned with the production of goods and services through the use of optimal quantities of inputs to produce the maximum possible production at the lowest cost, and when the economy is producing within the limits of the production possibility, this indicates production efficiency. (*i.e.,* it is impossible to produce more than one commodity without sacrificing units of other commodities.

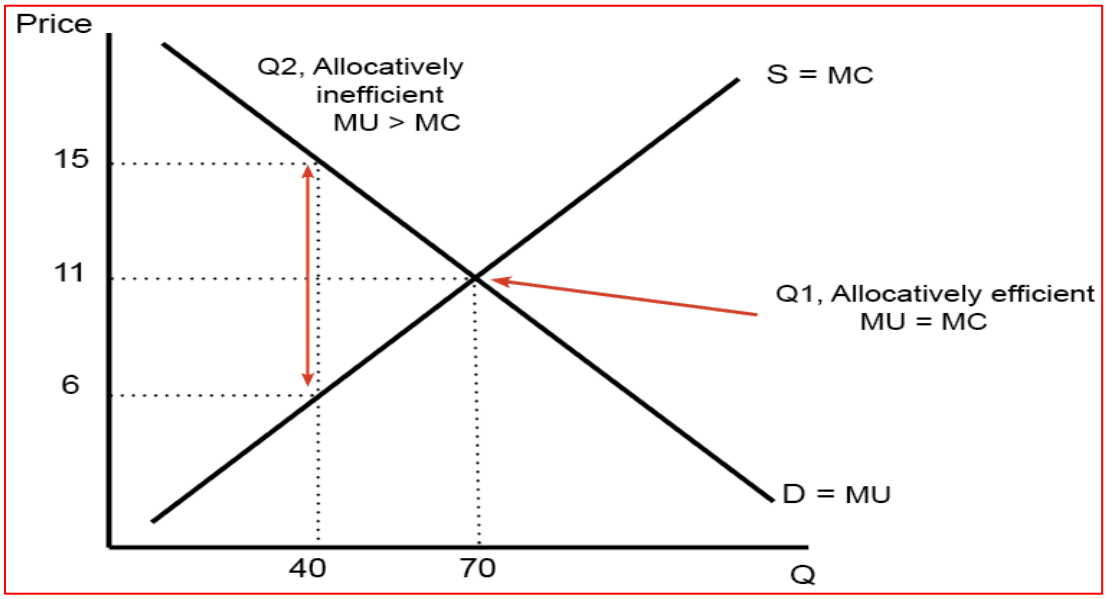

FIGURE 1
ALLOCATIVE EFFICIENCY (WWW.ECONOMICSHELP.ORG)

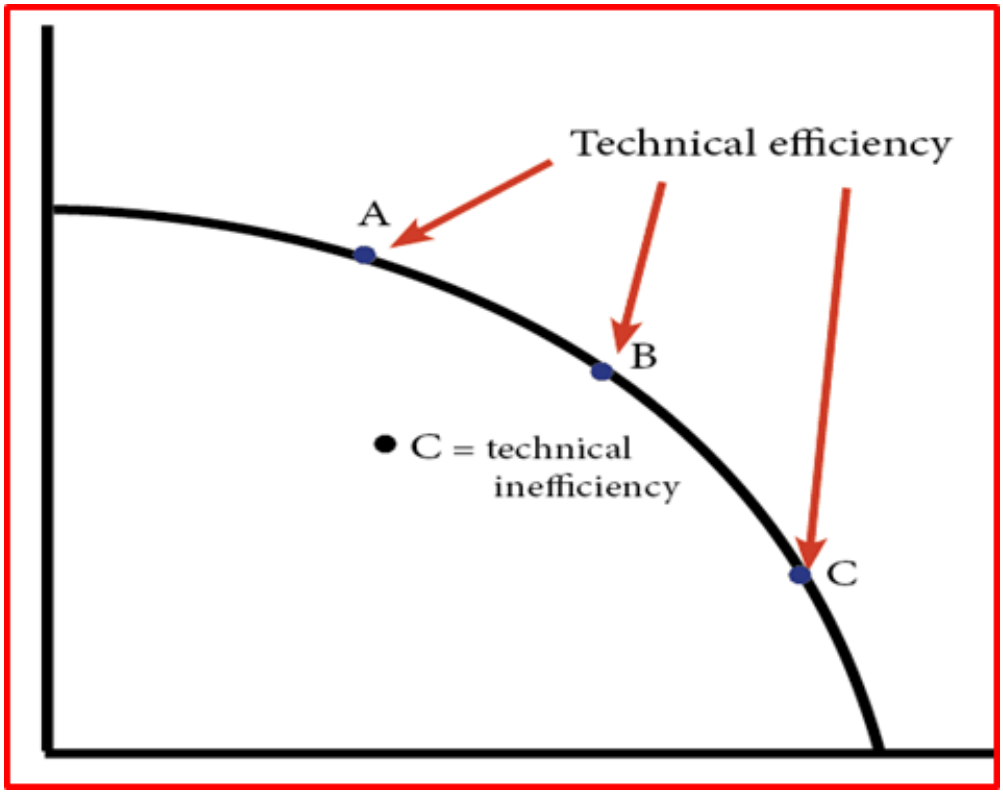

FIGURE 2
TECHNICAL EFFICIENCY

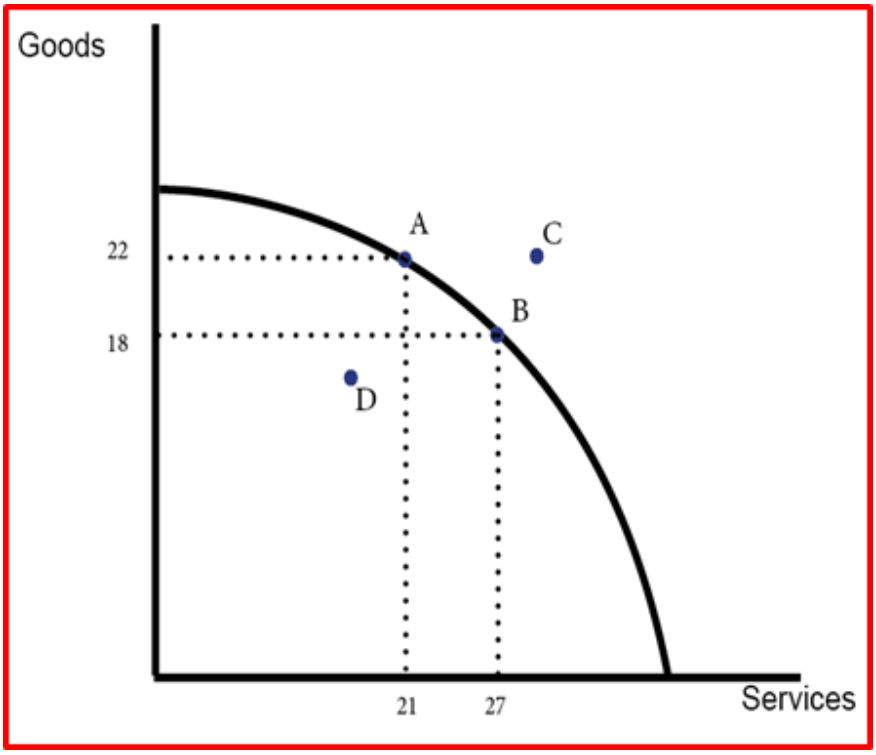

FIGURE 3
PRODUCTIVE EFFICIENCY

METHODOLOGY

The research used method of Data Envelopment Analysis (DEA) to evaluate the variable and fixed economic efficiency for agricultural banks sector in Iraq. The study sample involved two Iraqi agricultural banks, the Cooperative Agricultural Bank and the Turkish Agricultural Banks for the period 2015-2020. The data collection sources used in the current research are based on the data published in the annual reports. This study depends on the results of the statistical and economic analysis of the data collected from the annual reports to measure the efficiency achieved.

Measurements of Variables

This paper used the most important indicators used worldwide to measure the efficiency in the banking sector, shown in the following table:

Table 1
SUMMARY OF VARIABLES MEASUREMENT

Dependent Variables	Acronym	Description
Total banking facilities	Y1	Total credit facilities
Net annual profit	Y2	Net income
Independent Variables	Acronym	Measurement
Total deposits	X1	Investment accounts, Current accounts, Demand deposits, Investment deposits
Bank capital	X2	The value of cash funds
Y1+ Y2	→	Outputs
X1+ X2	→	Inputs

Dea Model

"Satisficing DEA The non-parametric DEA model was first presented –in its current form – by Charnes, Cooper & Rhodes (1978). Using Linear Programming (LP), it solves the relative efficiency of a group of DMUs (Decision Making Units) based on a linearized sum of weighted inputs and outputs (Kruger, Steyn, & Kearney, 2002; Wanke, 2012). Consider a set of n observations on each one of the DMUs, where DMUo represents the specific DMU under assessment. Each observation, DMUj (j=1,…, n) uses m inputs xij (i=1,…,m) to produce s outputs yrj (r=1,…,s). Precisely, xio and yro are the ith input and rth output for DMUo, respectively. Model (1) presents the envelopment model form for the Constant Returns-to-Scale (CRS) assumption with output orientation (Bazargan & Vasigh, 2003; Zhu, 2003). If one wants to impose a Varying Returns-to-Scale (VRS) assumption, a constraint where lambdas add up to one should be incorporated into Model (1), as presented in Banker, Charnes & Cooper (1984); Chen, et al., (2018).

Data Source

The data collection sources used in the current research are based on the data published in the annual reports for Turkish Agricultural Bank for each year from 2015-2020 and Agricultural Cooperative Bank (ACB) of Iraq.

RESULTS

Descriptive Statistics (T.A.B)

The table 2&3 shows the results of the descriptive statistical analysis of the inputs and outputs that were used in measuring the efficiency of agricultural banks in Iraq. This research based on annual data for the agricultural banks located in Iraq from 2015-2020. An average output of total credit facilities was found to be 36.12 md/ Iraq with minimum and maximum outputs of 1.00 and 207 md/ Iraq respectively. While the average value of the variable(x1) was 32.939 md/ Iraq with minimum and maximum deposits were 16.33 and 59.34 md/ Iraq. Moreover, the average of bank capital(x2) was 37.96 md/ Iraq with minimum and maximum approximate 24.53-70.73 md/ Iraq respectively. Above all, the standard deviation of the inputs and outputs of the standard model was 76.42, 19,24 and 15,45 respectively. It is worth mentioning (md) denotes the value of the figures in Iraqi currency, which is one million dinars.

Table 2
AGRICULTURAL BANKS (A.C.B) AND (T.A.B)

Bank	Years	Y1	Y2	X1	X2
A.C.B	2015	1.658.684	853	2.296.219	100.6
A.C.B	2016	1.804.321	13.225	2.210.074	100.6
A.C.B	2017	2.031.083	780	2.108.654	100.6
A.C.B	2018	1.750.257	16.536	2.129.581	100.6
A.C.B	2019	1.824.530	26	2.390.335	100.6
A.C.B	2020	1.891.628	10.539	2.408.727	100.6
T.A.B	2015	1.715	0	16.338	30.056
T.A.B	2016	1.205	0	16.506	26.739
T.A.B	2017	4.477	0	16.506	24.539

T.A.B	2018	1.001	0	29.596	40.708
T.A.B	2019	207	0	59.346	70.375
T.A.B	2020	1.317	0	59.346	35.365

Table 3
DESCRIPTIVE STATISTICS FOR INPUT AND OUTPUT(T.A.B)

Descriptive statistics	Y1	Y2	X1	X2
MEAN	36.119	0	32.939	37.963
MEDIAN	1.516	0	23.051	32.71
Standard deviation	76.429	0	19.241	15.457
MIN	1.001	0	16.338	24.539
MIX	207	0	59.346	70.375
Total	216.715	0	197.638	227.782

Descriptive Statistics (A.C.B)

The Table (4) shows the results of the descriptive statistical analysis of the inputs and outputs that were used in measuring the efficiency of agricultural Cooperative bank in Iraq. This research based on annual data for the Agricultural Cooperative Bank located in Iraq from 2015-2020. An average output of total credit facilities was found to be 1.82 md/ Iraq with minimum and maximum outputs of 1.65 and 2.03 md/Iraq respectively.

While the average value of the variable (y2) was 283.21 md/Iraq with minimum and maximum net income were 11 and 853 md/ Iraq. Moreover, the average value of the variable(x1) was 2.25 md/Iraq with minimum and maximum deposits were 2.108- 2.408 md/Iraq. While the average of bank capital(x2) was 100.6/ Iraq with minimum and maximum approximate 100.6 md/ Iraq respectively. Above all, the standard deviation of the inputs and outputs of the standard model was 115878.1527, 117460.0642, 117460.1 and 1,421 respectively. It is worth mentioning (md) denotes the value of the figures in Iraqi currency, which is one million dinars.

Table 4
DESCRIPTIVE STATISTICS FOR INPUT AND OUTPUT (A.C.B)

Descriptive statistics	Y1	Y2	X1	X2
MEAN	1.826.751	283.216	2.257.265	100.6
MEDIAN	1.814.426	2.253.147	2,253.15	101
Standard deviation	115878.153	117460.06	117460.1	1.421
MIN	1.658.684	11	2.108.654	100.6
MIX	2.031.083	853	2.408.727	100.6
Total	7.446.822	2.371.754	9.145.253	1.824

EFFICIENCY INDICATORS (A.C.B)

Table (5) offers a summary of the efficiency measures of the Agricultural Cooperative Bank of Iraq in our sample for each year. What we focus on in our research Cost Efficiency (CE) measures for Bank (A.C.B), which ranged from (0.750) to (1.000), While averaging over a period of study (0.846). The main purpose of efficiency analysis is to guide input correctly. Cost efficiency is an important criterion for problematic agricultural loans and inefficient banks (Achard & Bullmore, 2007).

The first and second columns refer to technical efficiency from CRS DEA and technical efficiency from VRS DEA respectively. In Column (3) technical efficiency was moderately efficient in 2015, but in 2017 its efficiency scale increased from (0.895) in 2016 to (1.000) in 2017, While the average during the study period was (0.902). Column (4) shows the allocative efficiency using specialized function model costs ranged between a minimum value reached (0.875) in 2020 and a high (1.000) in 2017, while the average of allocative efficiency was (0.937). Often the concept of specialized competence is associated with the concept of input productivity (Linarello, Petrella & Sette, 2019).

Results showed column (5) in 2015, cost efficiency is considered to be low by a difference of 25% compared to 2017, so the inputs must be increased in order to achieve a balance between inputs and outputs to become more effective in facing the economic crises that often affect the banking sector. Column (6) indicates the returns to scale that were increasing throughout the study period and are calculated according to the equation scale efficiency=crste/vrste,while the average returns Size was (0.902). Finally, we must also point out that all the following tables refer to the VRS results.

Table 5
EFFICIENCY INDICATORS BANK (A.C.B)

Years	CRSTE	VRSTE	TE	AE	CE	SCALE
2015	0.817	1	0.817	0.918	0.75	0.817IRS
2016	0.895	1	0.895	0.954	0.853	0.895IRS
2017	1	1	1	1	1	1
2018	0.87	1	0.87	0.99	0.861	0.870IRS
2019	0.898	1	0.898	0.882	0.792	0.898IRS
2020	0.936	1	0.936	0.875	0.82	0.936IRS
MEAN	0.902	1	0.902	0.937	0.846	0.902
IRS=Increase Return Scale						

Efficiency Indicators (T.A.B)

Table (6) presents a summary of the efficiency measures of the Turkish Agricultural Bank of Iraq in our sample for each year from 2015-2020. Cost Efficiency (CE) measures for Bank (T.A.B), which ranged from (0.008) in 2020 and (1.000) 2019, While averaging over a period of study(0.187). The first and second columns refer to technical efficiency from CRS DEA and technical efficiency from VRS DEA respectively. CRS value reached a minimum of (0.01) in 2018 and a maximum of (1.000) in 2019, while VRS also was wobbling between (0.603-1.000). Column (3) technical efficiency it only achieved efficiency in 2019, But it did not achieve in the others years, While the average during the study period also was inefficient (0.192).

Column (4) shows the allocative efficiency using specialized function model costs ranged between a minimum value reached (0.633) in 2019 and a high (1.000) in 2020, while the average of allocative efficiency was (0.823). Results showed column (5) cost efficiency is considered to be low during the period 2015-2020, so the inputs must be increased in order to achieve a balance between inputs and outputs to become more effective in facing the economic crises that often affect the banking sector. Column (6) indicates the returns to scale that were increasing throughout the study period and are calculated according to the equation scale efficiency=crste/vrste,while the average returns Size was (0.194). Finally, we must also point out that all the following tables refer to the VRS results.

Comparison between (T.A.B) and (A.C.B)

Table 7 shows the comparison between the Agricultural Cooperative Bank and the Turkish Agricultural Bank for the period 2015-2020. In general, looking at the results of the analysis of the levels of efficiency for each year we notice a clear decrease in the level of efficiency for the Turkish Agricultural Bank during the study period compared to its agricultural cooperative counterpart. In contrast, the TE was reached by the Agricultural Cooperative Bank in that period (0.902) and this result reflects the level of high performance efficiency compared to the Turkish Agricultural Bank. On the other hand, the average allocative efficiency of A.C.B bank has reached (0.937) which refers that those banks can perform with best practices by producing 93% of output with the same level of inputs.

Table 6
EFFICIENCY INDICATORS BANK (T.A.B)

Years	CRSTE	VRSTE	TE	AE	CE	SCALE
2015	0.03	1	0.03	0.726	0.022	0.030 IRS
2016	0.021	0.996	0.021	0.806	0.017	0.021 IRS
2017	0.078	1	0.078	0.861	0.067	0.078 IRS
2018	0.01	0.603	0.01	0.91	0.009	0.016 IRS
2019	1	1	1	1	1	1.000 -
2020	0.013	0.694	0.013	0.633	0.008	0.018 IRS
MEAN	0.192	0.882	0.192	0.823	0.187	0.194
IRS=Increase Return Scale						

The average DEA-CF efficiency scores for the Agricultural Cooperative Bank of Iraq during the study period was about 84%, This indicates that the maximum production can be produced by this bank which has the same level of inputs in Iraq and that the technology provided by the state is 84% (Alandejani & Asutay, 2015).

Table 7
COMPARISON BETWEEN (T.A.B) AND (A.C.B)

Years	Banks	TE	AE	CE
2015	T.A.B	0.03	0.726	0.022
2016	T.A.B	0.021	0.806	0.017
2017	T.A.B	0.078	0.861	0.067
2018	T.A.B	0.01	0.91	0.009
2019	T.A.B	1	1	1
2020	T.A.B	0.013	0.633	0.008
2015	A.C.B	0.817	0.918	0.75
2016	A.C.B	0.895	0.954	0.853
2017	A.C.B	1	1	1
2018	A.C.B	0.87	0.99	0.861
2019	A.C.B	0.898	0.882	0.792
2020	A.C.B	0.936	0.875	0.82
Mean	T.A.B	0.192	0.823	0.187
Mean	A.C.B	0.902	0.937	0.846

DISCUSSION

Agricultural loans have a direct effect on banks operational efficiency in agricultural sector. In addition, regulations and rules in the agricultural loans sector will play important role in the agricultural banks efficiency. The results showed that all efficiency averages and performance using DEA during 2015-2020 for Agricultural Cooperative Bank were high. This finding agrees with the previous study of Novickytė & Droždz (2018), they mentioned that the efficiency makes banks more flexible to economic disturbance, thereby significantly and positively affecting growth. The findings of this paper prove that applying DEA provides statistically better measures of economic efficiency, and this conclusion is consistent with a study of Sahoo, et al., (2020) The comparison between the Agricultural Cooperative Bank and the Turkish Agricultural Bank for the period study proved the superiority of the Agricultural Cooperative Bank superiority. This finding agree with the pervious study of Sakouvogui & Shaik, et al., (2020), they indicated that the efficiency between private and public banks is uneven and larger and older banks performed better in both the models. On the other hand, the decrease in the level of efficiency for the Turkish Agricultural Bank during the study period not agree with Harimaya & Kagitani (2019). They mentioned that the economic efficiency of agricultural banks was stable and efficient during the study period.

IMPLICATIONS

The results highlighted earlier lead to some implications. The debate on these implications will be divided into two parts, namely, theoretical and practical.

Theoretical Perspective: First of all, the results enrich the Concepts of allocative efficiency, technical efficiency and economic efficiency. Concepts related to efficiency measurement of agricultural banks were conceptualized in this study. Moreover, this study would contribute to clarifying the levels of efficiency in agricultural banks in order to avoid wasting money. Subsequently, this study contributes to both academic and responsible individuals. The results may have some important implications for economic policy.

Practical Perspective: The importance of increasing economic efficiency in agricultural banks will serve as a guideline for workers in the agricultural banking sector. The agricultural banks that work on exaggerating loans will know their limits in conducting their commercial activities that should not be beyond the limits of logic and affect shareholders in a negative way and cause a loss of financial liquidity. Therefore, regulators should make an effort to encourage agricultural banks to compete with each other to achieve optimum levels of efficiency. This is not only for the benefit of the agricultural banks but also for the public and the shareholders as a whole.

RECOMMENDATION AND LIMITATION

The current research tested Agricultural Cooperative Bank and the Turkish Agricultural Bank for the period 2015-2020 in Iraq. This study recommends that subsequent studies could consider the use of advanced parametric methods, random border methods, and a comparison between banks. Our study suggested examining the same variables but another method like stochastic efficiency analysis, and adding a new variable that measures instability periods for same banks. On the other hand, this study strongly recommend the researcher to investigate the same variables that adopted by the Search but in doing a comparative study between the agricultural banking sector in Iraq with another country.

The study is only limited to giving another perspective on methods of measuring efficiency in agricultural banks in Iraq for the period 2015-2020 through the data envelope method.

CONCLUSION

This study presents the results of the analytical process for measuring the efficiency of Iraqi agricultural banks using nonparametric model of DEA from 2015-2020. The research emphases on the Cost efficiency because is an important criterion for problematic agricultural loans and inefficient banks. These time periods allowed us to analyze the efficiency of the agricultural banking sector in Iraq to achieve main purpose of efficiency analysis is to guide input correctly. Generally, the results exposed that all means of efficiency declined in Turkish Agricultural Bank for the period 2015-2020. The results illustration that all efficiency averages and performance using DEA during 2015-2020 for Agricultural Cooperative Bank were high. Overall, the results show that the Agricultural banking sector in Iraq were increasing throughout the study period and are calculated according to the equation scale efficiency=crste/vrste. Finally, we must also point out that all the tables refer to the VRS results. With regard to further methodological improvement to measure efficiency in the agricultural banking sector.

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