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Data Envelopment Analysis (DEA) Approach for the Jordanian Banking Sector's Performance

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Abstract

This study sought to evaluate the performance of banks in the Jordanian banking sector, where DEA approach has been used for a sample of banks operating in Jordan amounted to 16 banks (10 Jordanian banks and 6 foreign banks operating in Jordan) during 2014 and by using the variables: Deposits and liabilities**,** Total expenses and Dedicated asset as main inputs for banks and which represent the main activity of banks, and the variables : Credit facilities and Net Income as outputs of the banks using the statistical software SIAD.

The current study has concluded that all banks operating in Jordan have a surplus in resources untapped optimally and over the investment opportunities available to these banks, and the reason beyond this may be due to the reservation policy of banks, especially after the mortgage crisis suffered by these banks. The study has also concluded that foreign banks operating in Jordan have achieved efficiency ratio more than the Jordanian banks, and this can be attributed to the financing experience of foreign banks' managements and their international spread which is more than the Jordanian banks'.

Keyword: data envelopment analysis, banking sector, Jordan

1. Introduction

Bank efficiency analysis is considered vital for the government, banks managements, Stock market and investors. Regulatory measures imposed by the government undoubtedly affect the banks' efficiency in converting inputs into outputs, (Berger, Hunter and Timme, 1993). The efficient performance of banks helps them survive and enables them to better compete and is necessary to boost confidence of dealers, whereas without confidence, the probability of banks' exposure to the risk of failure increases, and with it the possibility of bankruptcy increases also.

The Jordanian financial system is considered as a bank-based financial system where banks play a major role in financing the activities of the economy (World Bank, 2003). The Jordanian banking system is considered as a unique system of its kind as it consists of two systems; the conventional banking system (commercial banks) and the Islamic banking system.

Islamic banks offer financing and banking services in accordance with Islamic laws. There are three Islamic banks working in Jordan; The Jordan Islamic Bank for Finance and Investment, Jordan Dubai Islamic Bank, and the Islamic International Arab Bank PLC. The main principle of the Islamic bank is the prohibition of "Riba" or interest rate**.**

The Central Bank of Jordan organizes and controls the work of the banks operating in Jordan whether conventional or Islamic banks. Central Bank of Jordan was established in 1964 as an independent institution acting as a financial agent for the government, as it organizes the banking sector and gives permits for the establishment of new financial institutions (Khamis, 2003). Jordanian banking sector is considered as an advanced sector as compared to the countries of the Middle East and North Africa, and despite the decline in the role of banks in developed economies, resulting from the competition with other financial institutions in the investment and finance fields and directing borrowers to lenders directly, but the banks in Jordan are still occupy the top in these areas.

The Jordanian banking sector is the main source of credit because the capital market is still in the stage of development and growth. The banking sector is considered as one of the most important economic sectors in

Jordan and the most advanced in terms of growth, activity, level of development and use of technology and information, in addition to that it employs more than (13500) employees. The Jordanian banking sector contributes to 15.6% of GDP, and this is considered from higher contribution rates among the other various economic sectors which reflects the relative importance of the financial sector.

The Jordanian banking system - which consists of 26 banks divided into 13 commercial banks (which operate a network of the branch consisting of 609 branches in Jordan, and 163 branches abroad) , 3 Islamic banks (which operate 113 branches in Jordan and 15 branches abroad) and 10 foreign banks ,9 of which are commercial banks (which operate 52 branches in Jordan and 6 branches abroad) and one Islamic bank (which operates 3 internal branches) –has grown during the past years at high rates that reflected the success of banks in the field of savings and as an important financier for the national economy in various institutions and sectors, also reflected the efficiency of the banking system and its ability compared to the rates prevailing in many Arab countries.

Although there are a large number of studies that have focused on the study and analysis of the banking sector efficiency, but few of these studies were on developing countries, where the majority of these studies have been on developed countries, with a particular focus on the banking sector in the USA being the strongest economically. Accordingly, the objective of this study is to assess the relative efficiency of the Jordanian banks during the period 2005-2015, which is the period after Jordanian banks deregulation.

In this study, the researcher will apply Data Envelopment Analysis approach (DEA) due to its features on the Jordanian banks listed at Amman Stock Exchange (ASE) in order examining the efficiency of these banks. Envelopment Analysis approach (DEA) is considered as a non-parametric tool that uses linear programming techniques to evaluate and measure the efficiency of the decision-making units, whether at banks , hospitals or any other economic institution provided that the relative homogeneity between these units exists; this means the units to be compared use the same inputs and produces the same outputs.

Accordingly, the study seeks to answer the following questions:

1. Are Jordanian banks efficient in the use of resources and inputs?

2. Are efficiency levels linked to the size of the bank?

In order to achieve the objectives of the study and to answer its questions, the study has been divided into related literature review section which presents a literature related to the subject of study. Sample, tools and variables of the study section summaries the data utilized. Empirical findings section provides the empirical results and the Conclusion section which addresses conclusions based on the findings of the study.

2. Related Literature Review

The concept of efficiency in the banking and financial institutions is the same in economic institutions in principle, as the term (Efficiency) means optimum utilization of resources, or to achieve maximum output within available resources, whether for financial or economic institutions, but the difference may emerge when determining the inputs and outputs of banking institutions as compared to the economic institutions which production processes are clear, while banks are considered as(Multi-product financial firms) where their activities multiple ,vary and overlap.

Works of banks are characterized by change, innovation and constant development both in terms of financing instruments, banking services, the use of modern technology, or in terms of the environment in which the bank operates. Accordingly, the production process at the bank seems more complicated and intertwined than in economic institutions. Researchers were different as to identify activities that are inputs or outputs for financial institutions through the proposal of three basic ways to determine the input and output activities which are: Assets, Used Cost and Value Added (Hiller R. L. et al 1993). In applied studies of banking efficiency researchers have provided two approaches to measure the outputs; Proactive approach productivity, by which inputs and outputs are measured based on the number of accounts, number of loans or number of deals. The second approach is Mediation approach where inputs and outputs are measured based on monetary units (David, C. W. and Paul W. W. (1995)

Since the mid-eighties DEA has become more widely used in the evaluation and measurement of the efficiency of the banking industry, where several studies (Sherman and Gold,(1985), Rangan and Aly (1988), Ferrier and Lovell (1990) and Leibenstin and Maital, (1992)) have concluded that DEA is the best for measuring the general technical efficiency.

Many researchers in developing countries have used DEA to evaluate banks efficiency, where (Al-Faraj et al 1990) have analyzed the Saudi banks efficiency. (Al Shammari et Salimi 1998) have carried out a study on the

analysis of the efficiency of the Jordanian banks using DEA. (Hassan et al 2004) have carried out a study on the evaluation of the banks efficiency in the Kingdom of Bahrain using DEA. (Al-Muharrami (2007) has carried out a study on banks efficiency in GCC. (Mostafa M. M. 2007) has analyzed the efficiency of Arab banks using DEA, and (Al-Khathlan and Abdul-Malik 2010) have carried out a study of the analysis of Saudi bank's efficiency using DEA.

3. Sample, Tools and Variables of the Study

Study sample was determined based on the data and information available in the reports of the banks in their websites and Amman Stock Exchange website. Study sample included 16 banks of the 26 banks operating in Jordan divided into 10 Jordanian banks: (A, B, C, D, E, F, H, J, M, and O), and 6 foreign banks working in Jordan (G, I, K, L, N and P), which data of 2014 were collected.

As for the study tool, DEA approach was used through the application of two models; Charnes–Cooper–Rhodes (CCR) model and Banker–Charnes–Cooper (BCC) model what suits the objectives and the nature of banks' activity which represent decision-making units in the current study. Due to integration and correlation of both models (CCR and BCC) applied outputs of both models will be integrated to serve the objective of the current study.

With respect to the study variables, and because banks are multi-product financial firms, it is difficult to deal with all inputs and outputs of these institutions, and therefore, variables of the current study will be limited to the variables that clearly reflect the main activity of banks.

The variables of the model determined for the current study include:

1. Outputs: two main outputs constituting the main inputs for the main activity of banks and contribute to increased profits of the bank were determined and selected as follows:

a. Credit facilities: which reflect the main activity of the bank and are represented by the assets in the budget of the bank symbolized as (μ_1).

b. Net income : which reflects the bank's ability to manage its core banking operations, and represents the difference between interest earned from commissions , revenues and expenses paid in the form of benefits and commissions and symbolized as (μ_2).

2. Inputs: where three key variables that reflect the main activity of banks and have an impact on banks outputs and as follows:

a. Deposits and liabilities: which represent the main source of banks and which include liabilities in the budget symbolized as (λ_1).

b. Total expenses: This include services expenses, users expenses, taxes and bank's various expenses and fees and which are symbolized as (λ_2)**.**

c. Dedicated asset depreciation: which is represented by the allocations of depreciation and losses of fixed and non-fixed-asset values, symbolized as (λ_3).

Table 1 shows study sample and data of study variables in millions of dollars for the year 2014.

Table 1. Bank sample, variables of the study in millions of dollars for the year 2014

Bank's Code	Output		Input		
	Credit Facilities μ_1	Net Income μ_2	Deposits and Liabilities λ_1	Total expenses λ_2	Dedicated asset depreciation λ_3
A	2540	64	4621	109	101
B	1845	66	3069	86	78
C	740	14	1476	45	26
D	3837	175	9261	260	270
E	986	34	2163	39	18
F	412	3	745	30	12
G	1750	37	2803	63	81
H	710	19	1346	35	31
I	645	17	931	28	41
J	1122	51	2425	58	54
K	452	13	1052	15	10

L	1441	63	2911	105	67
M	1555	63	2613	91	120
N	1696	48	2848	127	129
O	662	19	2032	45	18
P	15609	508	30818	619	908

Source: Data from the annual reports of the banks published on their websites and the websites of the Amman Stock Exchange.

4. Empirical Findings

(CCR and BCC) models application process using SIAD has shown the results contained in table 2 and which were collected from Efficiency Scores table and Efficient References table.

Column no.2 from table no. 2 shows the Full efficiency scored by the study according to (CCR) model, while columns 3 and 4 from table no.2 show Scale efficiency and Technical efficiency of banks according to (BCC) model where Scale efficiency and Technical efficiency are considered as the Full efficiency according to the following equation:

$$CCR = BCC,$$

$$Full\ efficiency = Scale\ efficiency\ X\ Technical\ efficiency \quad (1)$$

Table no. 2 shows that banks (B, G, L and N) have scored Full efficiency (1.00) according to (CCR) model, In other words, these banks have scored 100% efficiency, and therefore, they form the efficient limits of study sample and these banks form the efficiency for their selves and for the other banks. Also, these banks have scored **%100**Scale efficiency and Technical efficiency at both levels.

The bank (P) was efficient at Technical efficiency level but it was inefficient at Scale efficiency level because their efficiency rate was less than 100%.

The banks (A, C, D, E, F, H, I, J, K, M and O) were inefficient at both Scale efficiency level and Technical efficiency level, and of course, in efficient at Full efficiency level.

It should be noted here that these results depend on the inputs and outputs that have been relied on in the study sample, and the change of any variable in the inputs or outputs, through addition or reduction, will lead to a change in the results that have been reached.

Table 2. Results of SIAD analysis

Bank's Code	CCR	BCC		Level of efficiency	Bank Reference
	Full efficiency	Scale efficiency	Technical efficiency		
A	0.655	0.805	0.813	Medium	B, I
B	1.000	1.000	1.000	Full	B, G, I
C	0.536	0.729	0.736	Weak	B, I
D	0.379	0.612	0.618	very weak	G, I
E	0.476	0.687	0.694	Weak	G, I
F	0.628	0.789	0.797	Medium	B, G, I
G	1.000	1.000	1.000	Full	B, G, I
H	0.601	0.771	0.779	Medium	B, I
I	1.000	1.000	1.000	Full	B, G, I
J	0.482	0.691	0.698	Weak	G, I
K	0.419	0.644	0.651	Weak	B, G
L	1.000	1.000	1.000	Full	B, G, I
M	0.740	0.856	0.864	Acceptable	B, G, I
N	1.000	1.000	1.000	Full	B, G, I
O	0.238	0.486	0.491	very weak	B
P	0.990	0.990	1.000	Technical	G, I

Source: SIAD program outputs.

Table 3 shows that the model variables (λ1, λ2, λ3, μ1, μ2) have differently affected the degree of efficiency of the banks under study. Table 3 also shows that the desired improvement of the variable λ_1 which represents

Deposits and liabilities was very low as compared to 4other variables. The reason for this is that there is an excess of untapped cash in Jordanian banks, so that the cash of Jordanian banks is significantly higher than the used amounts.

Table 3. Improvement required levels of inefficient banks

	Input and Output		Actual	Target	desired improvement	Ratio improvement
A	Input	λ_1	4621	4265.2	(355.82)	7.7%
		λ_2	109	88.7	(20.27)	18.6%
		λ_3	101	88.1	(12.93)	12.8%
	Output	μ_1	2540	3690.6	1150.62	45.3%
		μ_2	64	69.2	5.18	8.1%
C	Input	λ_1	1476	1288.5	(187.45)	12.7%
		λ_2	45	36.6	(8.37)	18.6%
		λ_3	26	25.4	(0.57)	2.2%
	Output	μ_1	740	760.0	19.98	2.7%
		μ_2	14	14.9	0.92	6.6%
D	Input	λ_1	9261	7232.8	(2028.16)	21.9%
		λ_2	260	225.7	(34.32)	13.2%
		λ_3	270	262.7	(7.29)	2.7%
	Output	μ_1	3837	4101.8	264.75	6.9%
		μ_2	175	190.2	15.23	8.7%
E	Input	λ_1	2163	1496.8	(666.20)	30.8%
		λ_2	39	32.6	(6.44)	16.5%
		λ_3	18	15.3	(2.72)	15.1%
	Output	μ_1	986	1068.8	82.82	8.4%
		μ_2	34	37.2	3.16	9.3%
F	Input	λ_1	745	587.8	(157.20)	21.1%
		λ_2	30	26.0	(3.99)	13.3%
		λ_3	12	11.0	(0.96)	8.0%
	Output	μ_1	412	428.5	16.48	4.0%
		μ_2	3	3.2	0.25	8.2%
H	Input	λ_1	1346	1172.4	(173.63)	12.9%
		λ_2	35	27.9	(7.07)	20.2%
		λ_3	31	21.3	(9.70)	31.3%
	Output	μ_1	710	743.4	33.37	4.7%
		μ_2	19	20.3	1.29	6.8%
J	Input	λ_1	2425	1903.6	(521.38)	21.5%
		λ_2	58	57.2	(0.81)	1.4%
		λ_3	54	40.9	(13.07)	24.2%
	Output	μ_1	1122	1150.9	28.95	2.6%
		μ_2	51	53.3	2.34	4.6%
K	Input	λ_1	1052	943.6	(108.36)	10.3%
		λ_2	15	13.2	(1.81)	12.0%
		λ_3	10	8.5	(1.45)	14.5%
	Output	μ_1	452	478.1	26.13	5.8%
		μ_2	13	13.9	0.85	6.5%
M	Input	λ_1	2613	2287.4	(325.58)	12.5%
		λ_2	91	60.0	(30.96)	34.0%
		λ_3	120	70.5	(49.45)	41.2%
	Output	μ_1	1555	1629.3	74.33	4.8%
		μ_2	63	69.2	6.21	9.9%
O	Input	λ_1	2032	1962.5	(69.49)	3.4%
		λ_2	45	35.4	(9.65)	21.4%
		λ_3	18	15.4	(2.59)	14.4%
	Output	μ_1	662	700.9	38.86	5.9%

		μ_2	19	20.9	1.88	9.9%
P	Input	λ_1	30818	26603.6	(4214.36)	13.7%
		λ_2	619	530.4	(88.58)	14.3%
		λ_3	908	685.1	(222.91)	24.6%
	Output	μ_1	15609	16529.3	920.31	5.9%
		μ_2	508	532.3	24.33	4.8%

Source: SIAD program outputs**.**

The results in Table 3 also show that the efficiency degrees and reference banks were in favor of foreign banks operating in Jordan, where Table 3 shows that bank B is the only Jordanian bank among the 10 banks of study sample which achieved Full efficiency while the three foreign banks (G, L and N) among the 6 foreign banks of the study sample have achieved Full efficiency. The foreign bank P has achieved **%100** Technical efficiency.

This means that foreign banks were more efficient than the Jordanian banks, and this may be due to the management of foreign banks, banks' management's banking experience in terms of source management ,the level of technological progress and use in these banks and their international spread.

5. Conclusions

This study sought to evaluate the performance of banks in the Jordanian banking sector, where DEA approach has been used for a sample of banks operating in Jordan amounted to 16 banks (10 Jordanian banks and 6 foreign banks operating in Jordan) during 2014 and by using the variables: Deposits and liabilities**,** Total expenses and Dedicated asset as main inputs for banks and which represent the main activity of banks, and the variables : Credit facilities and Net Income as outputs of the banks using the statistical software SIAD.

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