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RESEARCH ARTICLE

Analysis of Factors Influencing the Efficiency of Iraqi Commercial Banks

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ABSTRACT

The study aims to assess bank efficiency and identify its key explanatory factors using a sample of 18 Iraqi bank over the period from 2013 to 2022. The Data Envelopment Analysis (DEA) is employed to measure bank efficiency, while the panel data techniques are used to examine its determinants. In addition, we apply the Excel Solver function to determine how we should adjust inputs and outputs in order to reach full efficiency. Our findings reveal that the efficiency of Iraqi commercial banks is affected mainly by the activity and the leverage levels. In contrast, no significant relationship is documented between bank efficiency and liquidity, asset quality, leverage, bank size and bank age.

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INTRODUCTION

Since the subprime crisis of 2008, the debate on whether bank globalization contributes to improve bank efficiency and stability has become more prominent for policymaking (Yin, Yang and Lu, 2020). Indeed, the competition has expanded to include the global banking market. Given that banks have become in real confrontation with giant banks, they are called to develop their efficiency and productivity. This issue deserves the attention of policymakers since banks play a major role in boosting economic development. Thus, there is no doubt that the efficiency of the banking system is one of the most important requirements for reviving the economy. Due to the rapid change facing banking institutions, they have come under competitive pressures at the local and global levels, and in response to these pressures, they are seeking to find alternative solutions to reduce banking costs. Therefore, it seems interesting to assess bank efficiency and identify its explanatory factors.

The productive efficiency of the bank means its ability to maximize the production (outputs) of banking services using specific inputs (banking inputs) or the ability to reduce inputs while maintaining the level of production of banking services (outputs). Thus, the technical efficiency means the bank's ability to achieve the greatest output or service within a set of available resources. It is defined as the efficiency of investing the available resources from a technical standpoint to reach the highest levels in the areas of investing resources and reaching the goals desired to be achieved.

That is, productive efficiency expresses the relationship between the inputs of the productive process and the resources used, and when the bank's productive efficiency increases, this leads to reducing costs and thus reducing the prices of banking services and enhancing the banking competitiveness. Consequently, it increases the bank's profitability.

This productive efficiency can be achieved via one of the following alternatives:

A. Increasing the quantity of outputs while remaining the quantity of inputs constant.
B. Increasing the quantity of outputs at a rate higher than the rate of increasing the quantity of inputs.
C. The quantity of inputs decreases at a rate greater than the rate of increase in the quantity of outputs.

The existing literature suggests that various factors could affect bank efficiency. Alam (2012) examined the relationship between risk-taking and efficiency for 165 commercial banks and 70 Islamic banks from 11 emerging markets during the period 2000-2010. It concludes that risk and inefficiency are positively correlated.

Mesa, Sánchez, and Sobrino (2014) analyzed the link between bank efficiency and a set of bank specific-factors using a sample of 3952 banks operating in the European Union. They found that competition and lending diversification negatively affect the efficiency of banks, while the wholesale funding ratio and income diversification are positively associated with bank efficiency. In addition, bank size turns out to have a positive association with bank efficiency if the total assets do not exceed $25 billion.

Siagian (2023) investigated the explaining factors of operational efficiency using a sample of 28 banks listed on the Indonesia Stock Exchange. Their results reveal that bank efficiency depends on size, capital adequacy, loan-to-deposit ratio, net interest, and inflation, while credit risk and exchange rates have no a significant impact.

Nasim, Nasir and Downing (2024) used data from Using data from G7 and E7 countries from 2001 to 2020 to identify the factors affecting bank efficiency. Their findings reveal that bank efficiency is associated negatively to GDP, inflation, and capital adequacy and positively to uncertainty, leverage, bank rate and exchange rate.

Istaiteyeh et al. (2024) investigated the key financial indicators that influence the operational efficiency of banks in Jordan over the period 2006 to 2021. Using a sample of 15 banks, they documented a positive and significant correlation between the operating efficiency ratio and return on assets, bank size, and the ratio of loan loss provisions to net interest income, while a negative association is established between bank efficiency and the total expenses ratio. In contrast, no significant link is found between the operating efficiency ratio and credit risk, the equity-to-asset ratio, the deposit-to-liability ratio, and the equity-to-liability ratio.

This paper aims to examine the factors influencing operational efficiency using data from Iraqi commercial banks. Indeed, it seems very interesting to study bank efficiency in Iraq for three reasons. First, there is no consensus on the sources of inefficiency in the financial system (Berger and Mester, 1997). Second, there are scarce empirical studies that use data from countries other than USA and European countries. Third, previous studies have documented that the determinants of bank efficiency differ across countries (Dietsch and Vivas, 2000).

METHODS

Our sample consists of a balanced panel data comprising 18 Iraqi banks. The study period ranges from 2013 to 2022. Our main objective is to identify the factors affecting the bank efficiency. Thus,

we begin by measuring the bank efficiency using the Data Envelopment Analysis (DEA) then we apply the panel data techniques to determine its explanatory factors.

The DEA method is based on inputs represented by deposits, depreciation and expenses, and outputs represented by loans and bank income before tax. Table 1 reports the inputs and outputs used by the DEA to calculate the efficiency of Iraqi banks.

Table 1: Inputs and outputs of DEA

Bank	Inputs			Outputs	
	Deposits	Depreciations	Expenses	Loans	Income
1	173399833.40	418847.60	3509951.60	48805804.60	3525733.20
2	176491118	833.068	23361654	22645844	11234785
3	161931977	2474496	11681546	116411483	2699909
4	182252770	226.489	7930861	2340348	9109079
5	87003012	1453042	8783101	24446445	3800935
6	419896830	3574696	27527509	44461059	18768408
7	228479554	1718010	20773789	11911561	105629254
8	330079511	2950670	22846916	101531513	4717313
9	574166401	4833741	29523889	92545696	27863812
10	139254491	494.782	12134782	12604483	13283305
11	248941219	982.258	14899256	146971267	13413709
12	552457712	717.205	9396433	95612779	16771483
13	354490432	645.396	6978418	88876669	7798968
14	235626928	1726378	20071888	224280394	7735128
15	50317733	1378341	7044978	10538351	3354238
16	320261454	2662722	38219853	88088486	46649253
17	56799997	463.784	10808462	7870199	2150259
18	141241410	497.688	11896672	2949905	19172630
Min	50317733.00	226.49	3509951.60	2340348.00	2699909.00
Max	574166401.00	4833741.00	29523889.00	146971267.00	105629254.00
Mean	273413322.10	1362791.34	15548705.04	50922468.69	17564651.37

Applying the DEA method for these data, we obtain the efficiency level for each bank as displayed in table 2.

Table 2: Efficiency levels of the sample banks

Bank	Mean of inputs	Mean of outputs	Efficiency level
1	5233153.78	17732863.26	0.295
2	3388062.9	19985360.51	0.170
3	11911139.2	17608801.9	0.676
4	1144942.7	19018385.75	0.060
5	2824738	9723915.5	0.290
6	6322946.7	45099903.5	0.140
7	11754081.5	25097135.3	0.468
8	10624882.6	35587709.7	0.299
9	12040950.8	60852403.1	0.198
10	2588778.8	15138976.78	0.171
11	16038497.6	26384145.73	0.608
12	11238426.2	56185486.22	0.200
13	9667563.7	36146949.54	0.267
14	23201552.2	25742519.4	0.901
15	1389258.9	5874105.2	0.237
16	13473773.9	36114402.9	0.373
17	1002045.8	6760892.278	0.148
18	2212253.5	15313857.97	0.144

Table 2 shows the degree of banking efficiency of the Iraqi banks in the study sample, which is calculated by dividing the average outputs by the average inputs. It was found that the bank number 14 (the United Investment Bank) is the most efficient one, with an efficiency score of 0.901, while the least efficient is the bank number 4 (Credit Bank of Iraq), with an efficiency score equals 0.060.

Building on theories and previous empirical studies, we assume that the level of bank efficiency can be explained by a set of the following factors:

- **Liquidity:** The liquidity ratio equals to loans divided by customers' deposits.
- **Activity:** the activity ratio is defined by dividing net revenue by total assets.

- **Leverage:** the leverage ratio equals to liabilities divided by total assets.
- **Capital adequacy ratio (CAR):** the CAR is calculated by dividing a bank's capital by its risk-weighted assets.
- **Asset quality:** Asset quality is measured by dividing loan loss reserves by total loans.
- **Size:** The bank size is measured by the natural logarithm of total assets.
- **Age:** The age of the bank is measured by the number of years since its creation.

To assess the impact of these factors on bank efficiency, we apply the panel data techniques. The dependent and explanatory variables for panel data models are typically denoted using two subscripts indicating both sections and time. In this study, the dependent variable efficiency is assumed linearly related to the aforementioned explanatory factors. Thus, the model used in this study is specified as follows:

$efficiency_{it} = \alpha_i + \beta_1 liquidity_{it} + \beta_2 activity_{it} + \beta_3 leverage_{it} + \beta_4 CAR_{it} + \beta_5 Asset - quality_{it} + \beta_6 Size_{it} + \beta_{57} Age_{it} + \varepsilon_{it}$, i =1,…,18, t=1,…,10.

Using panel data can enhance the quality and quantity of data. It allows us to identify some effects that cannot be detected using time-series analysis. Panel data regression provides three estimators; Pooled OLS, Fixed effects, and Random effects models. A pooled estimator takes as the same across all cross-section units. The fixed effects model assumes the constant as a group specific term. The random effects approach takes the constant as a group specific disturbance. To choose between these three approaches we compute a test of homogeneity. If the calculated F statistic is lower than the tabulated F (p-value < 0.05), the null hypothesis is rejected and we have to choose between the fixed and the random effect models. If the effect is assumed to be individual, the Hausman specification test is carried out in order to decide whether the fixed or the random effects model should be used. The Hausman test compares the fixed and random effects estimates of coefficients. Under the null hypothesis, the individual effects are random and we then have to choose the estimator of GLS. Under the alternative hypothesis, the individual effects are correlated to the explanatory variables and we then have to choose the model to fixed effects. If calculated Chi-Square statistic is lower than tabulated (p-value < 0.05), the null hypothesis is rejected and individual effects are assumed fixed. However, if the p-value is greater than 5%, the random effect model is considered more appropriate.

RESULTS

Table 3 presents the descriptive statistics for the bank efficiency and their potential explaining variables. It is found that the p-value of the Jarque-Bera test for all variables is less than 5%, which indicates that they do not follow a normal distribution, but the normality condition can be ignored according the Central Limit Theorem since the number of observations is greater than 30.

The descriptives statistics indicate that:

- The average efficiency ratio is 0.37, with a standard deviation of 0.26. It is clear from this that the efficiency ratio of Iraqi banks is low according to the ratio of outputs to inputs.
- The average liquidity ratio was 0.37, and the standard deviation was 0.22, while the liquidity ratio ranged between 0.95 as the highest value and 0.01 as the lowest value.
- The average activity ratio in the banks in the study sample was equal to 0.37, and this is explained by the fact that every 1 Iraqi dinar invested in assets achieves a rate of 0.37 times the turnover rate, with a standard deviation estimated at 0.26, and the lowest value was 0.01, and the highest value was 1.
- The average leverage level is 0.64, and this indicates that 64% of the existing funds are the funds of others including deposits of all types. This ratio varies between 5.46 as the largest value and 0.01 as the lowest value with a standard deviation of 0.74.

- The average capital adequacy ratio is 2.28, which is equivalent to 228%. This indicates that Iraqi banks adhere to the standards of the Basel Committee by maintaining sufficient capital to confront risks, as the Basel Committee imposes a ratio of 8% of risk-weighted assets in order to maintain the bank's safety and efficiency. The standard deviation of this ratio equals 2.43, which is equivalent to 243% suggesting the existence of great divergence of capitalization level among Iraqi banks.
- The average asset quality ratio, measured by dividing the loss provisions by total loans, equals 0.46 which indicates that the level of bad loans in Iraqi banks is high.

Table 3: Descriptive statistics

	Efficiency	Liquidity	Activity	Leverage	CAR	Asset quality	Size	Age
Mean	0.37	0.37	0.37	0.64	2.28	0.46	10.02	1.15
Max	1	0.95	1	5.49	10.8	5.38	12.19	1.48
Min	0.01	0.01	0.01	0.01	0.05	-0.44	8.43	0.3
Std. Dev.	0.26	0.22	0.26	0.74	2.43	0.69	1.43	0.21
Skewness	0.77	0.67	0.74	4.88	1.56	4.34	0.33	-1.16
Kurtosis	2.52	2.66	2.4	30.23	4.4	25.39	1.22	4.58
Jarque-Bera	19.8	14.47	19.35	6278.72	88.01	4327	27.06	59.74
Probability	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Observations	180	180	180	180	180	180	180	180

To check the stationarity of our time series, we use The Augmented Dickey–Fuller (ADF) test. As can be seen, the results in Table 4 indicate the absence of a unit root at the level for all series. Thus, all series are stationary at level and can be incorporated in the model without need for first difference.

Table 4: ADF test for stationarity at level

Variables	ADF - Fisher Chi-square	ADF - Choi Z-stat	**p-value**
Efficiency	71.5828	-3.08105	0.000
Liquidity	81.6703	-3.88459	0.000
Activity	65.0495	-2.47774	0.000
Leverage	91.3007	-4.37001	0.000
CAR	68.9271	-3.32215	0.000
Asset quality	75.7002	-4.05947	0.000
Size	69.2895	-3.14409	0.000
Age	94.2615	-4.78125	0.000

The absence of multicollinearity among explanatory variables is an essential condition that should be verified to incorporate them in the same model. Indeed, if the independent variables are closely related, they begin to cancel each other out, leading to a decrease in the predictive power of the model. Thus, we ensure on the absence of multicollinearity problem by using the correlation matrix analysis and the Variance Inflation Factor (VIF). The results of these two methods displayed in tables 5 and 6, respectively, indicate that the multicollinearity problem does not occur among our independent variables. Therefore, they can be incorporated in the same model to explain bank efficiency.

Table 5: Correlation matrix

	Liquidity	Activity	Leverage	CAR	Asset quality	Size	Age
Liquidity	1.00						
Activity	0.60	1.00					
Leverage	-0.03	-0.16	1.00				
CAR	-0.05	-0.14	-0.12	1.00			
Asset quality	-0.08	-0.01	-0.06	0.07	1.00		
Size	0.00	0.01	0.12	0.26	0.00	1.00	
Age	0.08	-0.11	0.04	0.14	0.19	0.10	1.00

Table 6: Variance inflation factor (VIF)

	Coefficient
Variable	Variance
LIQUIDITY	1.10
ACTIVITY	1.32
LEVERAGE	1.14
CAR	1.21
ASSET QUALITY	3.70
SIZE	1.14
AGE	1.13

To test the homogeneity of the constant, we formulate the following hypothesis is:

H0: The Pooled model is appropriate.

H1: The fixed effects model is appropriate.

Table 7 reports the results of the homogeneity test of effects. It shows that the p-value for both Fisher and Chi-square tests is less than the 5% level of significance, and therefore the H0 hypothesis is rejected suggesting the presence of individual effects.

Table 7: Results of the homogeneity test

Effects Test	Statistic	d.f.		Prob.
Cross-section Chi-square	76.19628	18		0.000

To determine if these individual effects are fixed or random, we use the Hausman test. The Hausman test help as to choose which model we should use; the fixed effects or the random effects model. It tests for orthogonality of the random effects and the regressors. The specification test devised by Hausman (1978) is based on the idea that under the hypothesis of no correlation, both OLS and GLS are consistent, but OLS is inefficient, whereas under the alternative, OLS is consistent, but GLS is not. Therefore, under the null hypothesis, the two estimates should not differ systematically, and a test can be based on the difference. The Hausman test for fixed and random effects regression is based on the parts of the coefficient vectors and the asymptotic covariance matrix that correspond to the slopes in the models.

Let

$$q_1 = \hat{\beta}_{WG} - \hat{\beta}_{GLS}$$

Then under H_0 :

$$h = q_1' \left[\text{cov}\left(\hat{\beta}_{WG}\right) - \text{cov}\left(\hat{\beta}_{GLS}\right) \right]^{-1} q_1$$

h will be distributed as $\chi^2(K)$ with K degrees of freedom under the null hypothesis that the random effect is correct.

The results of the Hausman test reported in table 8 show that the p-value is less than 5% which indicates that the fixed effect model is more appropriate.

Table 8: Correlated random effects-Hausman Test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	p-value
Cross-section random	15.913617	7	0.0259

The results obtained using the fixed effect model are presented in table 9.

Table 9: Regression results of the factors influencing bank efficiency

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.3433	0.2309	1.4867	0.1391
Liquidity	0.1434	0.0910	1.5767	0.1169
Activity	0.2726	0.0815	3.3437	0.0010
Leverage	0.0576	0.0258	2.2326	0.0270
CAR	-6.38E-05	0.0102	-0.0062	0.9950
Asset quality	-0.0111	0.0291	-0.3808	0.7039
Size	-0.0035	0.0156	-0.2217	0.8248

Age	-0.1079	0.1658	-0.6475	0.5183
R-squared		0.3184		
Adjusted R-squared		0.2128		
F-statistic		3.0163		
Prob(F-statistic)		0.0000		

Table 10 shows that that p- value of the F-statistic is 0.0000, which indicates that the model is globally statistically significant. The R-squared equals 31.84%, which suggests that the variables included in the model explain 31.84% of the change in the efficiency of the selected Iraqi commercial banks.

We can use the Excel Solver function to optimize the efficiency of the Iraqi banks and reach the level of 1 by adjusting on inputs and outputs of the DEA. The results obtained using the Excel Solver function are presented in table 8:

Table 10: The required improvements in inputs and outputs to reach full efficiency

Bank	Inputs			Outputs		Mean of inputs	Mean of outputs	Efficiency
	Deposits	Depreciations	Expenses	Loans	Income			
1	70756402.63	418248.71	3467894.72	71000973.91	3641561.42	7464253.533	7464254.606	1
2	30280423	833.06474	20799877	36449063	14632077	5108113.977	5108113.292	1
3	129474477	2466917	11512638	140741038	2712996	14345403.4	14345403.12	1
4	10439898	226.48873	7605512	2748804	15296833	1804563.722	1804563.676	1
5	30933585	1437403	8211683	36490577	4092090	4058266.747	4058267.091	1
6	65605055	3549018	26004822	71561345	23597541	9515888.526	9515889.618	1
7	132590537	1712588	19981094	12372943	141911328	15428427.12	15428421.91	1
8	132155291	2934854	21898677	152162250	4826608	15698885.88	15698882.14	1
9	132185353	4802416	28355261	133744527	31598493	16534302.01	16534302.99	1
10	25913727	494.78057	11274120	17958646	19229700	3718834.601	3718834.235	1

11	181519089	982.25695	1465774	182468486	13709393	19617787.89	19617781.49	1
12	148293635	717.20432	9279514	139453447	18120409	15757385.58	15757386.59	1
13	131632123	645.39526	6892054	130406064	8118750	13852481.46	13852482.18	1
14	223008713	1725701	1998032 4	236964664	7750216	24471487.96	24471473.79	1
15	11925675	1349533	6292387	15691319	3876273	1956759.255	1956759.405	1
16	136639553	2650029	3560471 9	119449827	55444453	17489428.01	17489430.14	1
17	7422818	463.78071	9020501	13847349	2596433	1644378.161	1644378.264	1
18	25846164	497.68657	1107798 9	3292212	33632438	3692464.981	3692465.161	1

DISCUSSION

Our findings reveal that the efficiency of Iraqi commercial banks is mainly affected by only two factors, namely activity and leverage. In contrast, the other factors, namely liquidity, CAR, asset quality, size and age turn out to have no significant effect on bank efficiency.

The variable "Activity", measured by net revenue reported to total assets, is positively and significantly associated with efficiency. An increase in the activity ratio by 1% leads to an enhancement of the bank efficiency by 27.26%.

The variable "Leverage", measured by dividing total liabilities by total assets, turns out to have a significant positive effect on bank efficiency. Indeed, the coefficient of this variable equals 0.0576 and the p-value is 2.7%. This indicates that an increase of the leverage level by 1% improves bank efficiency by 5.76%. This result corroborates with previous findings in Nasim, Nasir and Downing (2024) for banks operating in G7 and E7 countries.

Our finding on the absence of any significant association between bank efficiency and asset quality aligns prior finding Siagian (2023) for Indonesian banks but contradicts that of Istaiteyeh et al. (2024) for banks in Jordan and Alam for a sample of commercial and Islamic banks from 11 emerging markets.

In addition, we found no significant relationship between bank efficiency and capital adequacy, bank size, and liquidity and this result does not previous empirical findings such as those of Mesa, Sanchez and Sobrino (2014), Nasim, Nasir and Downing (2024) and Istaiteyeh et al. (2024).

CONCLUSION

This study examined the factors that influence the efficiency of Iraqi commercial banks over the period 2013-2023. We began by employing the DEA method to evaluate the efficiency of the selected

banks and then we applied the panel data techniques to identify the principal determinants of bank efficiency. We provided evidence that the efficiency of Iraqi commercial banks is affected mainly by the activity and the leverage levels. In addition, we applied the Excel Solver function to determine how we should adjust inputs and outputs in order to reach full efficiency. Our findings are important for bankers and policymakers since they can help them to consolidate the factors that increase bank efficiency.

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