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**Measuring the performance of the banking sector in Iraq using data
envelopment analysis**

Mamdooh Attallah Faihan*

College of Administration and Economics/University of Anbar

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***Corresponding author:**

Mamdooh Attallah Faihan

College of Administration and
Economics/University of Anbar



Abstract: Banking sector is one of the most important sectors that witnessed emergence of many private banks in the competitive markets. Therefore, evaluating and improving the efficiency of the banking sector has newly attracted increasing interest. In Iraq, the lack of interest in measuring the efficiency of banking sector by exploiting available resources to produce high level of outputs can be deemed the main issue of banks. This paper aims to measure and analyse the efficiency of banking sector in Iraq using the output-oriented BCC model of data envelopment analysis under variable returns to scale (VRS) technology. The model focuses on the trend of increasing outputs while keeping inputs at their current levels in order to maximise banks' outputs. To measure efficiency, this paper relies on a dataset of 18 Iraqi banks for the year 2025. The banks have been evaluated in terms of global technical efficiency, pure technical efficiency, scale efficiency, and returns to scale. The results show that, out of 18 evaluated banks, 11 banks achieved efficient status under VRS. The average efficiency score of the efficient and inefficient banks under VRS is 0.899, in which 0.101 of banks are inefficient. Moreover, benchmarks and targets of outputs for each inefficient banks have been identified to improve the production of outputs by identifying their optimum levels.

قياس أداء القطاع المصرفي في العراق باستخدام تحليل مغلف البيانات

ممدوح عطاالله فيحان

كلية الإدارة والاقتصاد/جامعة الأنبار

المستخلص

يُعد القطاع المصرفي من أهم القطاعات التي شهدت ظهور العديد من المصارف الخاصة في ظل الأسواق التنافسية؛ ولذلك، حظيت عملية تقييم وتحسين كفاءة هذا القطاع باهتمام متزايد في الآونة الأخيرة. وفي العراق، يُمكن اعتبار نقص الاهتمام بقياس كفاءة القطاع المصرفي -من حيث استغلال الموارد المتاحة لتحقيق مستويات عالية من المخرجات- التحدي الرئيسي الذي تواجهه المصارف. تهدف هذه الورقة البحثية إلى قياس وتحليل كفاءة القطاع المصرفي في العراق باستخدام نموذج "BCC" الموجه نحو المخرجات ضمن منهجية تحليل مغلف البيانات (DEA) وفي ظل افتراض العوائد المتغيرة للسعة (VRS). يركز النموذج على تعظيم مخرجات المصارف من خلال السعي لزيادة المخرجات مع الإبقاء على المدخلات عند مستوياتها الحالية. ولغرض قياس الكفاءة، تعتمد الدراسة على بيانات تخص 18 مصرفاً عراقياً لعام 2025، حيث تم تقييم هذه المصارف من حيث الكفاءة الفنية الكلية، والكفاءة الفنية الصرفية، وكفاءة السعة، والعوائد للسعة. وأظهرت النتائج أن 11 مصرفاً -من أصل 18 مصرفاً خضعت للتقييم- قد حققت حالة الكفاءة وفق نموذج العوائد المتغيرة للسعة (VRS). وبلغ متوسط درجة الكفاءة للمصارف (سواء الكفاءة أو غير الكفاءة) 0.899، مما يشير إلى وجود فجوة كفاءة بنسبة 0.101 لدى المصارف غير الكفاءة. وعلاوة على ذلك، تم تحديد المعايير المرجعية والمستويات المستهدفة للمخرجات لكل مصرف غير كفؤ، وذلك بهدف تحسين عملية إنتاج المخرجات من خلال تحديد مستوياتها المثلى.

الكلمات المفتاحية: كفاءة المصارف، القطاع المصرفي في العراق، تحليل مغلف البيانات.

1. Introduction

In the development of the financial system, the banking sector plays an increasingly critical role. The quality of services provided by banks has significant effects on the growth of a country's economic leading to improve daily lives of people. Due to technological advancement and the opening of financial markets, the banking sector has achieved rapid development (Wang et al., 2014). In Iraq, one of the significant challenges facing the Iraqi banking sector is that the Iraqi economy is a rentier economy relying on oil revenues to finance the majority of the public income. This result in limited exploitation of industrial opportunities, low levels of investment, high rates of unemployment, and the accumulation of public debts, which places a heavy financial burden on the country (Safi & Khelif, 2023). Moreover, digital transformation has made it necessary to climate electronic systems of payment, support economic and financial environment, and improve climate

of the international business to advance banking services in an increasingly competitive landscape.

In Iraq, depositors still have a fear depositing money in private banks due to a lack of trust and concern that these banks may not fulfill their obligations towards depositors in light of the exceptional circumstances and the state of uncertainty facing the Iraqi banking sector. Due to the complex operating situations of Iraqi banking sector, the efficiency should be measured and analysed effectively. A non-parametric approach termed data envelopment analysis (DEA) was first developed by Charnes et al. (1978) to evaluate the relative efficiency of decision-making units (DMUs) consume multiple inputs to produce multiple outputs, such as banks. Therefore, it has become one of the most widely used efficiency modelling techniques used to evaluate the efficiency of banking sector. Since banking sector in Iraq aims to increase outputs with the current level of inputs, the methodology is based on the output-oriented BCC model of Banker, Charnes, and Cooper (1984).

The contribution of this paper to current empirical research on Iraqi banking sector are as follows: first, for the first time, the concept of DEA methodology providing a comprehensive analysis of efficiency levels of inputs and outputs for measuring the technical efficiency is applied to assess the efficiency of Iraqi banking sector. Second, this paper examines nexus between depositors and bank efficiency. The applied methodological concept of DEA makes possible to quantify the negative impact of depositors fear on bank efficiency. Third, this research examines the impact of the restructuring programme on Iraqi banking sector.

The remaining of this paper is organized as follows: Section 2 provides an overview of the intermediation approach of the banking sector. Section 3 considers the methodology of DEA in evaluating efficiency of DMUs. Section 4 discusses the data and empirical results of Iraqi banking sector. Concluding remarks are summarised in Section 5.

- 2. The intermediation approach:** Most DEA studies evaluating banking sector used the intermediation approach because its interest on the financial intermediary role. The founders of this approach were first considered in Sealey and Lindley (1977). The approach aims to modelling behaviours of bank under profit-maximizing firms. The inputs and outputs, as well as output decisions are explicitly identified by the theory of positive price.

Financial intermediaries have considered as banking characterised. Frisc (1965) defined that inputs are objects entering a process, while outputs are objects emerging from a process. For the production process of a financial intermediary, aspects of both the technical and economic were captured Sealey and Lindley (1977). The transformation process of inputs and outputs are the basic concepts of the technical aspect. The economic sense of the process is to produce high-value outputs than that of inputs. The positive theory of firm behaviours aims to profit maximisation-making decision based on its revenue and private cost, which are measured explicitly in terms of market value.

In specific case of a bank, an output can be characterised as a service that its market value should be higher than original inputs. Therefore, outputs are services that provide to debtors. In turn, inputs are considered as services provided to depositors because the inputs incur costs without generating any direct revenue. The services of banking sector, such as, safekeeping, check clearing, and book keeping are considered as the positive cost. For the use of funds, these services of banking sector can also be considered as partial payment. In sum, the intermediation approach deals with inputs and outputs of an organisation based on both the preference and transformation process of intermediary services, with a focus on market value. Regarding inputs and outputs as measure variables, the monetary value of loan accounts and deposit can be used in the intermediation approach instead of the number of loan accounts and deposits.

In terms of the monetary value, banks contests to gain market share rather than the number of accounts as demonstrated in Kolari and Zardkoohi (1987). Humphrey (1985) deduced that the monetary value of the funds intermediated is more significant than the number of accounts. Besides, the intermediation costs and financial intermediary are incurred with the loans, deposits, and monetary value. Berger and Humphrey (1997) and Pasiouras (2010) concluded that the intermediation approach is the most widely that measures the bank efficiency compared to other approaches. Since the intermediation approach effectively and explicitly accounts for the related activities distinguishing banks from other types of firms, it has been widely supported for use in efficiency evaluation of banks. Because competitive banks strive to minimise the sum of operating expenses and interest expenses of outputs, the intermediation approach has been widely recognised as an

effective approach evaluates the competitive viability of banks (Berger et al. 1987; Wheelock and Wilson 1995). Therefore, the intermediation approach is superior in evaluating the banks efficiency at institutional over other approaches, as introduced in Berger and Humphrey (1997). Compared to other approaches, Cook et al. (2005) concluded that the intermediation approach is a more effective tool for assessing efficiency, as it provides a more accurate representation of how a bank can efficiently utilise its resources to generate profits.

Despite such broad application of the intermediation approach in bank efficiency studies, several shortcomings have raised. Firstly and most obviously for the intermediation approach, deposits is inputs justifies the importance of deposit services providing to customers by a bank, as well as the numerous operating cost associated with the deposits process. To produce loanable funds, deposits are considered as inputs. The outputs of fund functions—such as providing payments, safekeeping, and liquidity services to depositors—are ignored in the intermediation process. Furthermore, the relation between assets and deposits is not accounted. Secondly, the unique characteristics of a bank are not address; instead, it is treated as a regular financial intermediary, while channelling funds between borrowers and depositors, a bank participates also in the mechanism of the payment system, thus, the money supply to the economy are increased. Finally, the approach neglects aspects of non-interest related activities and risk management. As mentioned above, a bank can also be deemed as credit risk monitor and liquidity insurer. Hakenes (2004) discussed that risk management is a main area of intermediation activity. In banking today, the significant decrease in interest related activities and increase in non-interest related activities were proved by Allen and Santomero (2001). However, activities of loan granting and deposit issuing are primarily modelling by the intermediation approach, while the approach neglects non-interest related services and risk indicators.

- 3. Methodology:** DEA is a non-parametric approach of linear programming assesses the relative efficiency of decision-making units (DMUs), such as banks. Considering a set of n DMUs, each DMU_j consumes a vector X of m inputs and produces a vector Y of s outputs. The initial work of DEA introduced in Charnes et al. (1978), widely named as the CCR model, the

relative efficiency of DMU_j is measured by solving the following minimization linear programming problem.

To evaluation the efficiency of DMU_j ($j = 1, \dots, n$) using the output-oriented model, the dual problem of CCR model is represented in model (1).

$$= \theta_o \quad (1)$$

s.t

$$\sum_{j=1}^n x_{ij}\lambda_j \leq x_{io}, \quad i=1, \dots, m,$$

$$\sum_{j=1}^n y_{rj}\lambda_j \geq \theta_o y_{ro}, \quad r=1, \dots, s,$$

$$\lambda_j \geq 0, j = 1, \dots, n; \theta_o \text{ unrestricted in sign}$$

For the inputs and outputs, the CCR model assumes that the returns to scale is constant (CRS). Another version of CCR was improved by Banker, Charnes, and Cooper, (1984), termed BCC. The BCC model integrates a convexity constraint $\sum_{j=1}^n \lambda_j = 1$ for variable returns to scale (VRS) and has its own frontier spanned by the convex hull of the evaluated DMUs. The characteristic of BCC's frontier is piece-wise linear and concave, which identify the VRS. The mathematical linear programming form of the output-oriented BCC is presented in model (2).

$$= \theta_o \quad (1)$$

s.t

$$\sum_{j=1}^n x_{ij}\lambda_j \leq x_{io}, \quad i=1, \dots, m,$$

$$\sum_{j=1}^n y_{rj}\lambda_j \geq \theta_o y_{ro}, \quad r=1, \dots, s,$$

$$\sum_{j=1}^n \lambda_j = 1,$$

$$\lambda_j \geq 0, j = 1, \dots, n; \theta_o \text{ unrestricted in sign}$$

$x_{ij} \rightarrow$ i th input of DMU_j , $i = 1, \dots, m$ and $j = 1, \dots, n$

$y_{rj} \rightarrow$ r th output of DMU_j , $r = 1, \dots, s$ and $j = 1, \dots, n$

$\lambda_j \rightarrow$ intensity factor whose value is non –

negative and its weight corresponds to DMU_o

$\theta_o \rightarrow$

efficiency score corresponding to DMU_o being evaluated in the output – oriented BCC model

Since sizes of some assessed banks have very different ;therefore, it is suitable to run the BCC model under VRS. In this paper the output-oriented BCC model is applied to evaluate efficiency of Iraqi banking sector.

4. Results and Discussion: As considered in the methodology Section 3, an efficient bank should have the ability to increase its outputs, while keeping its inputs at their same levels. Thus, the DMU can reach the efficient frontier constructing by the efficient DMUs. This section applies the introduced methodology to evaluate the efficiency of banking sector in Iraq for year 2025. In fact, DEA is a non-parametric approach based on the linear programming. Therefore, the relationship between the inputs and outputs should be linear. For the utilised dataset in this paper, we examine the correlation coefficient between the variables using Pearson's correlation coefficient, as displayed in Table 1.

Table (1): Correlation matrix

	Capital	Labour	Deposit	Loans	Assets
Labour	0.477				
Deposit	0.486	0.852			
Loans	0.512	0.610	0.864		
Assets	0.601	0.810	0.954	0.887	
Investments	0.416	0.691	0.672	0.550	0.703

Table 1 reports that correlation between all inputs and outputs utilised in this paper are strong positive. Thus, the dataset can be involved into the BCC model. Hence, the overall technical efficiency under constant return to scale, pure technical efficiency under variable return to scale, scale efficiency, and returns to scale are calculated. The calculated efficiencies are tabulated in Table 2.

Table (2): Efficiency measures

DMUs	Global technical efficiency	Pure technical efficiency	Scale efficiency	Returns to scale
National Bank of Iraq	1.000	1.000	1.000	CRS
International Development Bank for Investment and Finance	0.835	0.970	0.861	IRS

DMUs	Global technical efficiency	Pure technical efficiency	Scale efficiency	Returns to scale
Bank of Baghdad	0.960	0.981	0.979	IRS
Middle East Iraqi Investment Bank	0.723	1.000	0.723	IRS
Gulf Commercial bank	1.000	1.000	1.000	CRS
Al Mansour Bank	1.000	1.000	1.000	CRS
Investment Bank	0.886	1.000	0.886	IRS
Credit Bank of Iraq	0.647	0.649	0.996	DRS
Economic Bank for Investment and Finance	0.454	1.000	0.454	IRS
Sumer Commercial Bank	0.345	0.814	0.424	IRS
Aljanoob Islamic Bank For Investment & Finance	0.647	0.649	0.996	DRS
Commercial Islamic bank of Iraq	1.000	1.000	1.000	CRS
Erbil Investment and Finance Bank	1.000	1.000	1.000	CRS
Iraqi Union Bank	0.756	1.000	0.756	IRS
Ashur International Bank	0.692	0.836	0.828	IRS
Kurdistan International Islamic Bank	0.518	0.534	0.970	IRS
Iraqi Islamic Bank	0.699	0.760	0.919	IRS
United Bank	1.000	1.000	1.000	CRS

Table 2 presents that six banks—National Bank of Iraq, Gulf Commercial Bank, Al Mansour Bank, Commercial Islamic Bank of Iraq, Erbil Investment and Finance Bank and United Bank—are overall technical efficient under the constant returns to scale (CRS) technology, five banks

are—Middle East Iraqi Investment Bank, Al Mansour Bank, Investment Bank, Economic Bank for Investment and Finance, and Iraqi Union Bank—are pure technical efficient DMUs under the variable returns to scale (VRS) technology. Besides, All banks classified as overall efficient are also scale efficient since these banks are efficient under CRS and VRS technologies. The scale efficiency is a ratio of CRS-efficiency score to VRS-efficiency score.

In DEA, technically inefficient DMUs under CRS and VRS may be scale efficient because their efficiency scores under CRS and VRS are the same. This property of DEA is not achieved in this study because the resulting efficiency scores of inefficient banks under CRS and VRS are not equal. These six banks classified as CRS are scale efficient banks since they are operating at the optimal economic size. The optimal economic size indicates that these banks utilised their resources efficiently, ensuring they play a crucial role in a competitive market. DEA classifies VRS increasing returns to scale (IRS) and decreasing returns to scale (DRS).

The IRS reflects that the proportional increasing in inputs (e.g., labor, capital, branches) are less than that of outputs (e.g., loans, deposits, financial services). In contrast, the DRS reflects that the proportional changes in inputs are greater than that of outputs. Based on these two assumptions, the number of banks operating under IRS and DRS are, respectively, ten and two, as presented in Table 2. The results of indicate that these ten banks are not yet operating at an optimal scale. Since most of the obtained efficiency scores under CRS and VRS are different, VRS is used to define the benchmarking and efficiency target of the inefficient banks.

Model (1) rates four efficient banks under VRS— Middle East Iraqi Investment Bank, Investment Bank, Economic Bank for Investment and Finance, and Iraqi Union Bank—. The average efficiency score of the evaluated banks under VRS is 0.899, in which 0.101 of banks are inefficient. This indicates that the evaluated banks have shortfalls in their outputs. Therefore, benchmarks of the inefficient banks need to be identified for efficiency improvement. These benchmarks are identified using model (1), as shown in Table 3.

Table (3): Benchmarks for inefficient banks

Inefficient banks	Peers' banks			
International Development Bank for Investment and Finance	Iraqi Union Bank	National Bank of Iraq		
Bank of Baghdad	Commercial Bank of Iraq	Economic Bank for Investment and Finance-	National Bank of Iraq	
Credit Bank of Iraq	Gulf Commercial bank	Erbil Investment and Finance Bank	Commercial Bank of Iraq	Al Mansour Bank
Al janoob Islamic Bank For Investment & Finance	Gulf Commercial bank	Erbil Investment and Finance Bank	Commercial Bank of Iraq	Al Mansour Bank
Ashur International Bank	Gulf Commercial bank	Al Mansour Bank	Commercial Bank of Iraq	Erbil Investment and FinanceBank
Kurdistan International Islamic Bank	Erbil Investment and Finance Bank	Al Mansour Bank		
Iraqi Islamic Bank	Middle East Iraqi Investment Bank	Al Mansour Bank	National Bank of Iraq	Erbil Investment and Finance Bank

The benchmark is based on an intensity factor (λ_j^*) value. The value of ($\lambda_j^* = 0$) states that an efficient bank “j” cannot be a benchmark for an inefficient bank. Contrastingly, a positive value of an intensity factor ($\lambda_j^* > 0$) states that the efficient bank “j” can be a benchmark for an inefficient bank. For example, efficient banks— Gulf Commercial bank, Erbil Investment and Finance Bank, and Commercial Bank of Iraq, and Al Mansour Bank are benchmarks for the inefficient bank of Credit Bank of Iraq. It is worth mentioning that each of the following banks— Iraqi Union Bank, Economic Bank for Investment and Finance, Middle East Iraqi Investment Bank, National Bank of Iraq, Gulf Commercial bank, Commercial Bank of Iraq, Erbil Investment and Finance Bank, Al Mansour Bank, —is referenced as a benchmark 1, 1, 1, 3, 3, 4, 5, and 5 times, respectively. The top-referenced banks— Erbil Investment and Finance Bank and Al Mansour Bank —utilize their inputs and produce their own outputs at a high level of performance.

Due to the prominent feature of the BCC model, the optimum level of financial resources used and outcomes produced to improve performance of inefficient banks can be identified by benchmarks for each inefficient bank.

Therefore, decision-makers rely on benchmarks to identify the targets required to help each inefficient bank to be efficient through decreasing inputs and increasing outputs. The targets can provide information for potential directions to improve the efficiency for each inefficient bank. For example, the inefficient banks—Credit Bank of Iraq, Aljanoob Islamic Bank for Investment & Finance, and Kurdistan International Islamic Bank—have lower efficiency scores compared to other inefficient banks. Therefore, these banks need to decrease their inputs and increase their outputs to more closely align with other inefficient banks. Table 4 presents targets of the inefficient banks.

Table (4): Targets of inefficient banks

Bank	Loans	Assets	Investment
Investment East Middle Iraqi bank	243900.209	667676.556	59705.137
Commercial Gulf bank	270897.3	1521320.662	118220.357
Mansour Bank for Investment	324928.972	1653786.474	26753.635
Union Bank of Iraq	360827.677	565100.948	971.862
Ashur International Bank	226470.492	755937.209	14408.159
Kurdistan International Bank for Investment and Development	139007.357	3227862.855	230917.556
Iraqi Islamic Bank for Investment and Development	747752.163	2830342.698	9787.068

- 5. Conclusion:** In Iraq, banking sector faces several challenges significantly effect of their performance, one of those challenges is that the Iraqi economy is a rentier economy relying on oil revenues to finance the majority of the public income. At most, this result leads to low levels of investment, high unemployment rates, and the accumulation of public debts, leading to a heavy economic burden financial on the country. Therefore, it becomes necessary to evaluate the financial process of banking sector. This paper aims to evaluate Banking sector of Iraq using output-oriented BCC model of DEA. The efficiency scores for pure technical, global technical, and scale efficiency for each DMU were calculated and reported. The results indicate that among the evaluated banks under VRS, 10 banks achieved fully efficiency—National Bank of Iraq, Middle East Iraqi Investment Bank, Gulf Commercial bank, Al Mansour Bank, Investment Bank, Economic Bank for

Investment and Finance, Commercial Islamic bank of Iraq, Erbil Investment and Finance Bank, Iraqi Union Bank, and United Bank.

These results indicate that these banks use their resources optimally, which affected their position in a competitive market. This means that these banks have achieved the best performance in producing output, and have served as a benchmark under VRS for other banks. The average efficiency score of the evaluated banks under VRS is 0.899, in which 0.101 of banks are inefficient. This indicates that the evaluated banks have shortfalls in their outputs. Therefore, benchmarks of the inefficient banks need to be identified for efficiency improvement. Benchmarks and target obtained from the BCC model for each inefficient bank were reported to improve the production of its outputs by identifying the optimum levels of outputs since the methodology is based on the output-oriented model.

Benchmarks and targets support the management of each inefficient bank to identify the closest target required by each inefficient bank. The aim of identifying these targets is to assure that each inefficient bank achieves its efficient status that enable it to suggest various strategies. As a matter of fact, the evaluation of banking sector in Iraq based on VRS because most of the obtained technical efficiencies under VRS are conflict with their corresponding efficiency scores resulting from CRS technology.

References

1. Allen F, Santomero AM, (1997) The theory of financial intermediation. *JBank Financ* 21(11-12):1461-1485.
2. Allen F, Santomero AM (2001) What do financial intermediaries do? *J Bank Financ* 25(2):271-294.
3. Banker, R. D., Charnes, A., & Cooper, W. W. (1984). Some models for estimating technical and scale inefficiencies in data envelopment analysis. *Management Science*, 30(9), 1078-1092.
4. Berger AN, Hanweck GA, HumphreyDB (1987) Competitive viability in banking: scale, scope, and product mix economies. *J Monetary Econ* 20(3):501-520.
5. Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. *European Journal of Operational Research*, 2, 429-444. [https://doi.org/10.1016/0377-2217\(78\)90138-8](https://doi.org/10.1016/0377-2217(78)90138-8).
6. Fethi MD, Pasiouras F (2010) Assessing bank efficiency and performance with operational research and artificial intelligence techniques: a survey. *Eur J Oper Res* 204(2):189-198.
7. Frisch R (1965) *Theory of production*. Reidel, Dordrecht.
8. Hakenes H (2004) Banks as delegated risk managers. *J Bank Financ* 28(10):2399-2426.

9. Humphrey DB (1985) Cost and scale economies in bank intermediation. In: Aspinwall RC (ed) Handbook for banking strategy. Wiley, New York, pp 745–783.
10. Kolari J, Zardkoohi A (1987) Bank costs, structure, and performance. Lexington books, Lexington.
11. Safi, M. H., & Khlif, H. (2023). The Impact of Financial Inclusion on Banking Stability- An Analytical Study in the Iraqi Banking Sector. American Journal of Applied Statistics and Economics, 2(1), 48–53.
12. Sealey CW, Lindley JT (1977) Inputs, outputs, and a theory of production and cost at depository financial institutions. J Financ 32(4):1251–1266.
13. Wang, K., Huang, W., Wu, J., & Liu, Y.-N. (2014). Efficiency measures of the Chinese commercial banking system using an additive two-stage DEA. Omega, 44, 5–20.
14. Wheelock DC, Wilson PW (1995) Evaluating the efficiency of commercial banks: does our view of what banks do matter? Review (July/August), Federal Bank Reserve of St. Louis, pp 39–52.