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ISOM7021 -BUSINESS MODELING AND DECISION ANALYSIS

Group Project Report

(First Semester, 2024/2025)

Title of the Project: Case Analysis—Comparation of Chinese Banks' Operational Efficiency By Using Data Envelopment Analysis

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Case Analysis—Comparation of Chinese Banks' Operational Efficiency By Using Data Envelopment Analysis

I. Introduction

In the current increasingly competitive banking environment, major banks not only face the challenge of internal management efficiency, but also need to constantly adapt to changes in the external market. To help banks improve operational efficiency and optimize resource allocation, our project introduces data envelopment analysis (DEA) method to conduct quantitative analysis on the efficiency performance of six banks, including Bank of China, Agricultural Bank of China, China Construction Bank, Industrial and Commercial Bank of China, Postal Savings Bank of China and Bank of Communications in multiple dimensions. By collecting and analyzing the key financial data of these banks, including fee and commission income, net loan, net profit, number of employees, deposits, net fixed assets, the project will reveal the operational efficiency of each bank, and provide suggestions for optimizing strategies and enhancing competitiveness of banks.

DEA, as a widely used method to evaluate the efficiency of decision-making units (such as banks, companies, etc.), calculates the relative efficiency value of each bank by constructing the input and output indicators of several banks. Different from the traditional single efficiency analysis method, DEA can process multiple inputs and outputs and can comprehensively reflect the performance of banks under different resource allocation conditions. In addition, this project integrates the cross-efficiency model, and further analyzes the relative advantages and disadvantages of each bank in its peers by evaluating the efficiency of banks under the weight system of other banks. This method can show the relative performance of different banks under different evaluation criteria, so as to provide data support for the bank's strategy optimization.

II. Goals and Innovation

The main objective of the project is to provide banks with a scientific assessment of operational efficiency through innovative data analysis methods and to provide data support for their strategic decisions. Specific Goals include:

(1) Operational Efficiency Assessment: The project assesses the operational efficiency of six banks by comparing their performance across multiple financial dimensions. These include fee and commission income, net loans, net profit, headcount, deposits and fixed assets to identify core

strengths and weaknesses.

(2) Data Envelopment Analysis (DEA): DEA is a non-parametric efficiency evaluation method that can comprehensively evaluate the technical efficiency and scale efficiency of various banks in multiple input and output dimensions. Through DEA model, the project will compare the efficiency performance of various banks under the same evaluation criteria and help identify the potential and shortcomings of their resource allocation and operation process.

(3) Cross-efficiency analysis: The project's innovative use of cross-efficiency models enables a more comprehensive and impartial assessment of each bank's efficiency. The model is used to calculate the efficiency value of each bank under the weight system of other banks, which can evaluate the performance of banks under different evaluation criteria. In this way, it reveals the relative performance of banks in different competitive environments and provide reference for their improvement strategies.

(4) Provide data support for bank optimization strategies: Through in-depth data analysis, the project helps banks to identify inefficient problems in which links and provides theoretical basis and data support for improving resource utilization efficiency, reducing operating costs, and optimizing income structure.

III. Methods

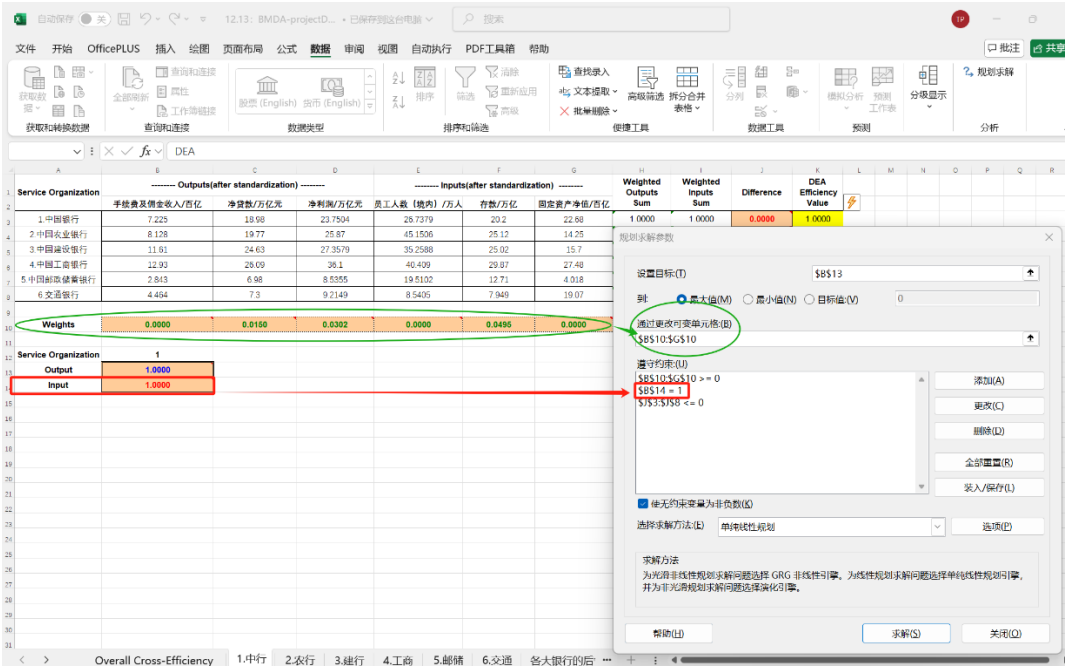
1. Data Envelopment Analysis (DEA)

Data Envelopment Analysis (DEA) is a nonparametric method based on linear programming for evaluating the relative efficiency of Decision-Making Units (DMUs, Decision Making Units) with multiple inputs and outputs. The core idea is to construct an efficiency frontier surface and compare the performance of all DMUs to this efficiency frontier. The efficiency value is calculated by the formula: **Efficiency value** = $\frac{\boldsymbol{Output\ Weights\ sum}}{\boldsymbol{Input\ Weights\ sum}}$

DEA allows each DMU to independently choose the weights that are most favorable to itself to maximize its efficiency value, and at the same time ensures that the efficiency value of all other DMUs does not exceed 1. DMUs with an efficiency value of 1 are considered efficient and are on the efficiency frontier, while DMUs with an efficiency value of less than 1 are regarded as inefficient. The advantage of DEA is that there is no need to preset the weights of inputs and outputs, which makes it suitable for complex multi-input and multi-output systems, and it can provide specific

improvement directions by analyzing the input-output gap of inefficient DMUs. Commonly used models include the CCR model (assuming constant returns to scale) and the BCC model (assuming variable returns to scale).

Figure 1.1 Constrains by using DEA



2. CCR model and Cross Efficiency Analysis

The purpose of our project is to compare the efficiency of the combined resource operations of different banks during the same year. The input and output variables of the banks are derived from the annual financial reports of the year, so these data are fixed and reflect the actual operating results and resource allocation of the banks in that year. To achieve this objective, the project first adopted the CCR model (DEA model with constant returns to scale) as the core methodology for efficiency evaluation.

The CCR model assumes constant returns to scale (CRS) and can provide a comprehensive measure of a bank's operational efficiency at current levels of inputs, independent of the direct effect of the size of the bank. This assumption is well suited to this project because the project objective is to assess the efficiency of the bank's output under fixed resource inputs, rather than analyzing the effect of size in isolation. By calculating a weighted ratio of input variables (e.g., net loans, net fixed assets) to output variables (e.g., deposits, fee income, number of employees), the CCR model defines an efficiency value and constructs an "efficiency frontier," where a bank with an efficiency value of 1 is used as a benchmark for comparison. Instead of presetting the weights of variables, the CCR

model uses linear programming to automatically assign optimal weights to each bank, thus evaluating the operational efficiency of multi-input and multi-output systems in a fair and scientific manner.

However, although the CCR model performs well in evaluating the operational efficiency of integrated resources, this project finds a potential limitation: because banks are free to choose the weights that are most favorable to them, **the efficiency value of many banks is equal to 1**. This "self-interestedness" masks the actual differences in the efficiency of banks and makes it difficult to distinguish between high and low levels of operational efficiency. This "self-interest" masks the actual efficiency differences among banks, making it difficult to effectively distinguish between high and low operational efficiency. To solve this problem, the project further introduces **Cross-Efficiency analysis** to enhance the differentiation ability of the model.

Through the mechanism of "mutual evaluation", each bank's efficiency value is not only determined by its own weights, but also evaluated by the weights assigned to other banks. Specifically, each bank's cross-efficiency value is the average of its efficiency value under the weighting system of other banks. This avoids the bias of a single bank relying solely on its own optimal weights and reveals its true relative efficiency. Using Bank of China as the example of calculation:

$\text{Cross Efficiency}_{\text{Bank of China}}$=AVERAGE($\text{Efficiency}_{\text{Bank of China}}$, Agricultural Bank of China+

$\text{Efficiency}_{\text{Bank of China}}$, China Construction Bank+

$\text{Efficiency}_{\text{Bank of China}}$, Industrial and Commercial Bank of China+

$\text{Efficiency}_{\text{Bank of China}}$, Postal Savings Bank of China+

$\text{Efficiency}_{\text{Bank of China}}$, Bank of Communications) According to the Cross Efficiency Value, we can know that if it is close to 1 indicates that the bank has a higher efficiency under the weight system of other banks, which means that its resource utilization and performance are more in line with the best practices of other banks; If the value is much lower than 1, it indicates that the bank's performance under the weight system of other banks is not as expected, and there may be insufficient resource allocation or low efficiency.

By combining the CCR model and cross-efficiency analysis, this project not only objectively evaluates the operational efficiency of each bank under fixed input and output conditions, but also effectively distinguishes the strengths and weaknesses of different banks. The results of cross-efficiency show that banks with significantly high efficiency values can be used as industry

benchmarks, while banks with lower efficiency have clear directions for improvement. Overall, the methodology provides a scientific, objective and highly differentiated efficiency evaluation framework for this project.

IV. Research Target

1.Subject introduction

This report selects the following six banks as research subjects for conducting Data Envelopment Analysis (DEA): Bank of China, Agricultural Bank of China, China Construction Bank, Industrial and Commercial Bank of China, Postal Savings Bank of China, and Bank of Communications. The reasons for selecting these banks for DEA analysis are explained below from the perspectives of feasibility and significance.

Feasibility of selecting these six banks for DEA analysis are evident. They are central to China's financial system with accessible operational data, offering a rich dataset. Their broad business scope, from corporate to personal finance and international settlements, along with specialized services in rural and inclusive finance, provides a comprehensive lens into banking efficiency. The moderate scale of these banks fits DEA's comparative analysis requirements, making them suitable for this study.

The significance of DEA on these banks is in evaluating resource allocation efficiency, crucial for maximizing outputs like profits and market share. It identifies inefficiencies, offers benchmarks for improvement, and assesses multi-dimensional competitiveness beyond traditional metrics, providing holistic performance insights. This analysis is essential for regulatory policy formulation to enhance industry health and efficiency.

2. Inputs and Outputs

In the Data Envelopment Analysis (DEA) framework, selecting appropriate input and output indicators is critical to accurately evaluate the efficiency of decision-making units (DMUs), in this case, the banks. Below, we explain the rationale for choosing the three output and three input indicators.

Reasons for Selecting the Output Indicators:

(1) Fee and Commission Income

Fee and commission income reflects the bank's ability to generate non-interest income, which is a key indicator of a diversified revenue structure. It highlights a bank's capability to provide financial services such as wealth management, insurance, and payment solutions, which are increasingly important in a modern banking environment. Including this indicator ensures that the analysis

captures how effectively a bank leverages its resources to generate value-added services and achieve competitive differentiation in the market.

(2) Net Loans

Net loans represent the core business of commercial banks, reflecting their lending activities and ability to support the real economy. As a fundamental source of interest income and profitability, this metric is essential for assessing how effectively a bank allocates its resources (e.g., deposits and capital) to generate loans. By including net loans, the analysis evaluates the bank's efficiency in performing its primary function of financial intermediation.

(3) Net Profit

Net profit is a comprehensive indicator of a bank's overall financial performance and operational efficiency, capturing the ultimate result of its business activities, including interest income, fee income, and cost control. It reflects the bank's ability to turn its inputs into financial gains. Including this metric ensures the DEA analysis evaluates the overall success of a bank in utilizing its resources to maximize profitability.

Reasons for Selecting the Input Indicators:

(1) Number of Employees

Employees are a significant input in the banking industry, as they drive customer service, sales, and operational processes. The number of employees reflects the human resource investment required to deliver banking services. By including this indicator, the analysis can assess how efficiently a bank utilizes its workforce to generate outputs (such as loans, fee income, and profit), highlighting the importance of labor productivity in the banking sector.

(2) Deposits

Deposits are the primary source of funding for banks and represent a key input for generating loans and other financial products. They reflect the bank's ability to attract and retain customer funds, which are critical for its operations. Including deposits allows the DEA analysis to evaluate how effectively a bank converts its funding base into productive outputs such as loans, fee income, and profit, demonstrating the efficiency of its financial intermediation process.

(3) Net Fixed Assets

Fixed assets, such as branch offices, IT infrastructure, and other physical resources, are essential for providing banking services and represent a significant investment in operational capacity. This

indicator captures the efficiency of a bank's capital investment in infrastructure and technology to support its business activities. Including net fixed assets ensures that the DEA analysis evaluates how well a bank utilizes its physical resources to generate outputs and sustain its operations.

V. Results of Chinese Banks

1. DEA

Data Envelopment Analysis (DEA) is a non-parametric efficiency evaluation method based on linear programming, primarily used to assess the relative efficiency of decision-making units (DMUs) with multiple inputs and outputs. DEA constructs a production possibility frontier to identify the optimal efficiency frontier and compares each DMU with this efficiency frontier to determine its relative efficiency value.

Specifically, in this example, the DEA model assumes that each bank (DMU) produces a set of standardized outputs (such as net loans, net profits, and fees and commission income) through a set of standardized inputs (such as the number of employees, deposit scale, and net value of fixed assets).

The calculation process of DEA can be divided into the following main steps:

(1) Constructing the Efficiency Frontier: Using linear programming methods, the efficiency frontier (Efficiency Frontier) is formed based on the most efficient DMUs. DMUs on the frontier are considered efficient (efficiency value of 1), while those below the frontier are considered inefficient (efficiency value less than 1).

(2) Relative Efficiency Calculation: For each DMU, DEA calculates the weighted ratio of its outputs to inputs, i.e., the efficiency score (Efficiency Score), with the formula:

Efficiency=Sum of Weighted Outputs/Sum of Weighted Inputs

The weights are automatically determined through the optimization model, with the aim of maximizing the efficiency score for each DMU. The efficiency score ranges from 0 to 1.

(3) DEA Calculation Process

① **Standardization of Inputs and Outputs:** The document lists relevant data for six banks, including: Output indicators: Fees and commission income, net loans, net profits. Input indicators: Number of employees (domestic), deposits, net value of fixed assets. Data is standardized to eliminate the impact of dimensions.

② **Calculation of Weighted Sums:** For each bank, the weighted sum of outputs and the weighted sum of inputs are calculated using the determined optimal weights:

Weighted Sum of Outputs=Fees and Commission Income×u1+Net Loans×u2+Net Profits×u3

Weighted Sum of Outputs=Fees and Commission Income×$v1$+Net Loans×$v2$+Net Profits×$v3$

Weighted Sum of Inputs=Number of Employees×v4+Deposits×v5+Net Value of Fixed Assets×v6

(4) Calculation Result

Bank of China:1

Service Organization	-------- Outputs(after standardization) --------			-------- Inputs(after standardization) --------			Weighted Outputs Sum	Weighted Inputs Sum	Difference	DEA Efficiency Value
	手续费及佣金收入/百亿	净贷款/万亿元	净利润/万亿元	员工人数（境内）/万人	存款/万亿	固定资产净值/百亿				
1.中国银行	7.225	18.98	23.7504	26.7379	20.2	22.68	1.0000	1.0000	0.0000	1.0000
2.中国农业银行	8.128	19.77	25.87	45.1506	25.12	14.25	1.0757	1.2436		
3.中国建设银行	11.61	24.63	27.3579	35.2588	25.02	15.7	1.1933	1.2386		
4.中国工商银行	12.93	26.09	36.1	40.409	29.87	27.48	1.4787	1.4787		
5.中国邮政储蓄银行	2.843	6.98	8.5355	19.5102	12.71	4.018	0.3618	0.6292		
6.交通银行	4.464	7.3	9.2149	8.5405	7.949	19.07	0.3870	0.3935		
Weights	0.0000	0.0150	0.0302	0.0000	0.0495	0.0000				
Service Organization	1									
Output	1.0000									
Input	1.0000									

Agricultural Bank of China:1

Service Organization	-------- Outputs(after standardization) --------			-------- Inputs(after standardization) --------			Weighted Outputs Sum	Weighted Inputs Sum	Difference	DEA Efficiency Value
	手续费及佣金收入/百亿	净贷款/万亿元	净利润/万亿元	员工人数（境内）/万人	存款/万亿	固定资产净值/百亿				
1.中国银行	7.225	18.98	23.7504	26.7379	20.2	22.68	0.9181	1.2621	-0.3440	0.7274
2.中国农业银行	8.128	19.77	25.87	45.1506	25.12	14.25	1.0000	1.0000	0.0000	1.0000
3.中国建设银行	11.61	24.63	27.3579	35.2588	25.02	15.7	1.0575	1.0575	0.0000	1.0000
4.中国工商银行	12.93	26.09	36.1	40.409	29.87	27.48	1.3954	1.6191	-0.2236	0.8619
5.中国邮政储蓄银行	2.843	6.98	8.5355	19.5102	12.71	4.018	0.3299	0.3757	-0.0458	0.8782
6.交通银行	4.464	7.3	9.2149	8.5405	7.949	19.07	0.3562	0.9107	-0.5545	0.3911
Weights	0.0000	0.0000	0.0387	0.0000	0.0167	0.0408				
Service Organization	2									
Output	1.0000									
Input	1.0000									

China Construction Bank:1

Service Organization	-------- Outputs(after standardization) --------			-------- Inputs(after standardization) --------			Weighted Outputs Sum	Weighted Inputs Sum	Difference	DEA Efficiency Value
	手续费及佣金收入/百亿	净贷款/万亿元	净利润/万亿元	员工人数（境内）/万人	存款/万亿	固定资产净值/百亿				
1.中国银行	7.225	18.98	23.7504	26.7379	20.2	22.68	0.8681	0.9513	-0.0832	0.9126
2.中国农业银行	8.128	19.77	25.87	45.1506	25.12	14.25	0.9456	0.9822	-0.0366	0.9627
3.中国建设银行	11.61	24.63	27.3579	35.2588	25.02	15.7	1.0000	1.0000	0.0000	1.0000
4.中国工商银行	12.93	26.09	36.1	40.409	29.87	27.48	1.3195	1.3195	0.0000	1.0000
5.中国邮政储蓄银行	2.843	6.98	8.5355	19.5102	12.71	4.018	0.3120	0.4511	-0.1391	0.6917
6.交通银行	4.464	7.3	9.2149	8.5405	7.949	19.07	0.3368	0.5203	-0.1835	0.6474
Weights	0.0000	0.0000	0.0366	0.0000	0.0309	0.0144				
Service Organization	3									
Output	1.0000									
Input	1.0000									

Industrial and Commercial Bank of China:1

Service Organization	-------- Outputs(after standardization) --------			-------- Inputs(after standardization) --------			Weighted Outputs Sum	Weighted Inputs Sum	Difference	DEA Efficiency Value
	手续费及佣金收入/百亿	净贷款/万亿元	净利润/万亿元	员工人数（境内）/万人	存款/万亿	固定资产净值/百亿				
1.中国银行	7.225	18.98	23.7504	26.7379	20.2	22.68	0.6579	0.6763	-0.0184	0.9729
2.中国农业银行	8.128	19.77	25.87	45.1506	25.12	14.25	0.7166	0.8410	-0.1244	0.8521
3.中国建设银行	11.61	24.63	27.3579	35.2588	25.02	15.7	0.7578	0.8376	-0.0798	0.9047
4.中国工商银行	12.93	26.09	36.1	40.409	29.87	27.48	1.0000	1.0000	0.0000	1.0000
5.中国邮政储蓄银行	2.843	6.98	8.5355	19.5102	12.71	4.018	0.2364	0.4255	-0.1891	0.5557
6.交通银行	4.464	7.3	9.2149	8.5405	7.949	19.07	0.2553	0.2661	-0.0109	0.9592
Weights	0.0000	0.0000	0.0277	0.0000	0.0335	0.0000				
Service Organization	4									
Output	1.0000									
Input	1.0000									

Postal Savings Bank of China:1

Service Organization	-------- Outputs(after standardization) --------			-------- Inputs(after standardization) --------			Weighted Outputs Sum	Weighted Inputs Sum	Difference	DEA Efficiency Value
	手续费及佣金收入/百亿	净贷款/万亿元	净利润/万亿元	员工人数（境内）/万人	存款/万亿	固定资产净值/百亿				
1.中国银行	7.225	18.98	23.7504	26.7379	20.2	22.68	2.7825	4.3128	-1.5302	0.6452
2.中国农业银行	8.128	19.77	25.87	45.1506	25.12	14.25	3.0309	3.0309	0.0000	1.0000
3.中国建设银行	11.61	24.63	27.3579	35.2588	25.02	15.7	3.2052	3.2706	-0.0655	0.9800
4.中国工商银行	12.93	26.09	36.1	40.409	29.87	27.48	4.2294	5.3649	-1.1355	0.7883
5.中国邮政储蓄银行	2.843	6.98	8.5355	19.5102	12.71	4.018	1.0000	1.0000	0.0000	1.0000
6.交通银行	4.464	7.3	9.2149	8.5405	7.949	19.07	1.0796	3.3928	-2.3132	0.3182
Weights	0.0000	0.0000	0.1172	0.0000	0.0258	0.1671				
Service Organization	5									
Output	1.0000									
Input	1.0000									

Bank of Communications:1

Service Organization	Outputs(after standardization)			Inputs(after standardization)			Weighted Outputs Sum	Weighted Inputs Sum	Difference	DEA Efficiency Value
	手续费及佣金收入/百亿	净贷款/万亿元	净利润/万亿元	员工人数（境内）/万人	存款/万亿	固定资产净值/百亿				
1.中国银行	7.225	18.98	23.7504	26.7379	20.2	22.68	2.4273	2.5412	-0.1139	0.9552
2.中国农业银行	8.128	19.77	25.87	45.1506	25.12	14.25	2.6529	3.1601	-0.5072	0.8395
3.中国建设银行	11.61	24.63	27.3579	35.2588	25.02	15.7	2.9112	3.1476	-0.2363	0.9249
4.中国工商银行	12.93	26.09	36.1	40.409	29.87	27.48	3.7577	3.7577	0.0000	1.0000
5.中国邮政储蓄银行	2.843	6.98	8.5355	19.5102	12.71	4.018	0.8810	1.5989	-0.7180	0.5510
6.交通银行	4.464	7.3	9.2149	8.5405	7.949	19.07	1.0000	1.0000	0.0000	1.0000
Weights	0.0351	0.0000	0.0915	0.0000	0.1258	0.0000				
Service Organization	6									
Output	1.0000									
Input	1.0000									

After our computational analysis, we found that the efficiency scores of the six banks are all 1, which indicates the following points:

All banks are on the efficiency frontier: An efficiency score of 1 means that these banks have achieved the optimal output combination under the given input conditions, meaning their resource use efficiency is considered optimal and cannot be further improved by adjusting weights or changing resource allocation.

To further distinguish between banks with an efficiency score of 1, the **Cross Efficiency DEA** method can be introduced. This method calculates cross-evaluated efficiency scores between banks, avoiding the overly flexible weight distribution issue in traditional DEA, and can more clearly reflect the relative efficiency levels of banks.

2. Cross Efficiency DEA

Bank of China: 0.84263897

Cross-Efficiency	Outputs(after standardization)			Inputs(after standardization)			Weighted Outputs Sum	Weighted Inputs Sum	Bank's Efficiency Value in weight system of the other 5 banks
Every Banks' best weights	手续费及佣金收入/百亿	净贷款/万亿元	净利润/万亿元	员工人数（境内）/万人	存款/万亿	固定资产净值/百亿			
1.中国银行	0	0.014954629	0.030153645	0	0.04950495	0			
2.中国农业银行	0	0	0.038654813	0	0.016656145	0.040813869	0.918067259	1.262112682	0.727405146
3.中国建设银行	0	0	0.036552513	0	0.030939721	0.014387783	0.868136809	0.951297269	0.912582046
4.中国工商银行	0	0	0.027700831	0	0.033478406	0	0.657905817	0.67626381	0.9728538
5.中国邮政储蓄银行	0	0	0.117157753	0	0.025839637	0.167142414	2.782543495	4.312750603	0.645189984
6.交通银行	0.035072849	0	0.091529458	0	0.125801988	0	2.427262574	2.541200151	0.955163871
Cross-Efficiency of 1.中国银行									0.84263897

Agricultural Bank of China: 0.903876447

Cross-Efficiency	Outputs(after standardization)			Inputs(after standardization)			Weighted Outputs Sum	Weighted Inputs Sum	Bank's Efficiency Value in weight system of the other 5 banks
Every Banks' best weights	手续费及佣金收入/百亿	净贷款/万亿元	净利润/万亿元	员工人数（境内）/万人	存款/万亿	固定资产净值/百亿			
1.中国银行	0	0.014954629	0.030153645	0	0.04950495	0	1.075727824	1.243564356	0.865035909
2.中国农业银行	0	0	0.038654813	0	0.016656145	0.040813869			
3.中国建设银行	0	0	0.036552513	0	0.030939721	0.014387783	0.945613516	0.982231687	0.962719415
4.中国工商银行	0	0	0.027700831	0	0.033478406	0	0.716620499	0.840977569	0.852127958
5.中国邮政储蓄银行	0	0	0.117157753	0	0.025839637	0.167142414	3.030871068	3.030871068	1
6.交通银行	0.035072849	0	0.091529458	0	0.125801988	0	2.652939196	3.16014593	0.839498952
Cross-Efficiency of 2.中国农业银行									0.903876447

China Construction Bank: 0.954608338

Cross-Efficiency	Outputs(after standardization)			Inputs(after standardization)			Weighted Outputs Sum	Weighted Inputs Sum	Bank's Efficiency Value in weight system of the other 5 banks
Every Banks' best weights	手续费及佣金收入/百亿	净贷款/万亿元	净利润/万亿元	员工人数（境内）/万人	存款/万亿	固定资产净值/百亿			
1.中国银行	0	0.014954629	0.030153645	0	0.04950495	0	1.193272931	1.238613861	0.963393813
2.中国农业银行	0	0	0.038654813	0	0.016656145	0.040813869	1.057514496	1.057514496	1
3.中国建设银行	0	0	0.036552513	0	0.030939721	0.014387783			
4.中国工商银行	0	0	0.027700831	0	0.033478406	0	0.757836565	0.837629729	0.904739337
5.中国邮政储蓄银行	0	0	0.117157753	0	0.025839637	0.167142414	3.205190088	3.270643604	0.979987573
6.交通银行	0.035072849	0	0.091529458	0	0.125801988	0	2.911249535	3.147565732	0.924920965
Cross-Efficiency of 3.中国建设银行									0.954608338

Industrial and Commercial Bank of China: 0.930042835

Cross-Efficiency	-------- Outputs(after standardization) --------			-------- Inputs(after standardization) --------			Weighted Outputs Sum	Weighted Inputs Sum	Bank's Efficiency Value in weight system of the other 5 banks
Every Banks' best weights	手续费及佣金收入/百亿	净贷款/万亿元	净利润/万亿元	员工人数（境内）/万人	存款/万亿	固定资产净值/百亿			
1.中国银行	0	0.014954629	0.030153645	0	0.04950495	0	1.478712871	1.478712871	1
2.中国农业银行	0	0	0.038654813	0	0.016656145	0.040813869	1.395438732	1.619084177	0.861869168
3.中国建设银行	0	0	0.036552513	0	0.030939721	0.014387783	1.319545725	1.319545725	1
4.中国工商银行	0	0	0.027700831	0	0.033478406	0			
5.中国邮政储蓄银行	0	0	0.117157753	0	0.025839637	0.167142414	4.22939488	5.364903475	0.788345009
6.交通银行	0.035072849	0	0.091529458	0	0.125801988	0	3.757705372	3.757705372	1
Cross-Efficiency of 4.中国工商银行									0.930042835

Postal Savings Bank of China: 0.650298464

Cross-Efficiency	-------- Outputs(after standardization) --------			-------- Inputs(after standardization) --------			Weighted Outputs Sum	Weighted Inputs Sum	Bank's Efficiency Value in weight system of the other 5 banks
Every Banks' best weights	手续费及佣金收入/百亿	净贷款/万亿元	净利润/万亿元	员工人数（境内）/万人	存款/万亿	固定资产净值/百亿			
1.中国银行	0	0.014954629	0.030153645	0	0.04950495	0	0.361759751	0.629207921	0.574944688
2.中国农业银行	0	0	0.038654813	0	0.016656145	0.040813869	0.329938152	0.375689731	0.878219779
3.中国建设银行	0	0	0.036552513	0	0.030939721	0.014387783	0.311993976	0.451053961	0.691699892
4.中国工商银行	0	0	0.027700831	0	0.033478406	0	0.236440443	0.425510546	0.555662946
5.中国邮政储蓄银行	0	0	0.117157753	0	0.025839637	0.167142414			
6.交通银行	0.035072849	0	0.091529458	0	0.125801988	0	0.880961799	1.598943263	0.550965015
Cross-Efficiency of 5.中国邮政储蓄银行									0.650298464

Bank of Communications: 0.659878606

Cross-Efficiency	-------- Outputs(after standardization) --------			-------- Inputs(after standardization) --------			Weighted Outputs Sum	Weighted Inputs Sum	Bank's Efficiency Value in weight system of the other 5 banks
Every Banks' best weights	手续费及佣金收入/百亿	净贷款/万亿元	净利润/万亿元	员工人数（境内）/万人	存款/万亿	固定资产净值/百亿			
1.中国银行	0	0.014954629	0.030153645	0	0.04950495	0	0.387031619	0.393514851	0.98352481
2.中国农业银行	0	0	0.038654813	0	0.016656145	0.040813869	0.356200232	0.91072018	0.391119292
3.中国建设银行	0	0	0.036552513	0	0.030939721	0.014387783	0.336827754	0.520314856	0.647353713
4.中国工商银行	0	0	0.027700831	0	0.033478406	0	0.255260388	0.266119853	0.95919333
5.中国邮政储蓄银行	0	0	0.117157753	0	0.025839637	0.167142414	1.079596977	3.392805101	0.318201885
6.交通银行	0.035072849	0	0.091529458	0	0.125801988	0			
Cross-Efficiency of 6.交通银行									0.659878606

VI. Conclusion

Based on the cross-DEA calculation results, it is evident that there are significant differences in operational efficiency among the banks. China Construction Bank and Industrial and Commercial Bank of China demonstrate the highest levels of efficiency, suggesting that their resource allocation and output management are highly optimized. These banks have effectively leveraged their market position, economies of scale, and diversified service portfolios to maintain competitive advantages. Their strong performance likely reflects effective cost control, high-quality asset management, and strategic focus on profitable business segments.

In contrast, the Postal Savings Bank of China and Bank of Communications exhibit relatively low efficiency scores. For the Postal Savings Bank, its extensive branch network, which targets rural and underserved areas, may contribute to higher operational costs and lower profitability per customer. This highlights the challenge of balancing financial inclusion with operational efficiency. The Bank of Communications, on the other hand, might face issues related to suboptimal capital utilization or inefficiencies in key business processes, which hinder its ability to compete with more agile or better-structured peers.

The Bank of China and Agricultural Bank of China fall into a middle range of efficiency. While

their performance is not as strong as the leaders, they still maintain respectable efficiency levels. However, the Bank of China may need to improve its output efficiency in certain business areas, potentially through better technological integration or streamlining operations. The Agricultural Bank, with its strong focus on rural finance, might benefit from further modernizing its service delivery to enhance productivity and meet evolving customer demands.

Overall, the analysis highlights the need for lower-performing banks to address specific inefficiencies, whether through better technology adoption, operational restructuring, or refined strategic focus. Meanwhile, high-performing banks should continue leveraging their strengths while exploring opportunities for innovation and sustained growth.

References

中国建设银行 2023 年年度报告
www3.ccb.com/chn/attachDir/2024/04/202404221506241279O.pdf
中国工商银行股份有限公司 2023 年度报告
fileDownLoad.do
中国邮政储蓄银行股份有限公司 2023 年年度报告及审计报告
iftp.chinamoney.com.cn/dqs/cm-s-notice-query/fileDownLoad.do?mode=open&contentId=2838858&priority=0
交通银行股份有限公司 2023 年度报告.pdf
chinamoney.com.cn/dqs/cm-s-notice-query/fileDownLoad.do?mode=open&contentId=2841519&priority=0
中国农业银行股份有限公司 2023 年度报告.pdf
https://www.chinamoney.com.cn/dqs/cm-s-notice-query/fileDownLoad.do?mode=open&contentId=2846689&priority=0
中国银行股份有限公司 2023 年年度报告.pdf
pic.bankofchina.com/bocappd/report/202403/P020240328746205158238.pdf