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ARTICLE

Efficiency of Deposit Money Banks and its Determinants in Nigeria: A Stochastic Frontier Analysis.

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Abstract

This paper investigates the profit efficiency of deposit money banks in Nigeria and examines whether macroeconomic conditions help explain observed efficiency outcomes. The study is motivated by the central role of banks in financial intermediation and by the difficult macroeconomic environment facing Nigeria in recent years, including elevated inflation and uneven output growth. Official statistics indicate that headline inflation remained exceptionally high in 2024 and that real GDP growth, while positive, was moderate, underscoring the relevance of macroeconomic conditions for bank performance. Using panel data for fourteen licensed deposit money banks over 2011–2024, the study estimates a translog profit frontier within the stochastic frontier analysis framework and then applies a dynamic panel generalized method of moments estimator to assess the effects of macroeconomic variables on estimated profit efficiency. The results show that Nigerian banks operate below the profit frontier, with an average profit efficiency score of 0.820, implying that roughly 18% of potential profit is lost to inefficiency. Inflation exerts a negative and statistically significant effect on profit efficiency, whereas GDP growth is not individually significant, although the joint effect of macroeconomic conditions is significant. The paper contributes to the literature by focusing on profit, rather than cost or technical efficiency, and by linking frontier-based efficiency estimates to macroeconomic determinants in the Nigerian banking context. The findings suggest that macroeconomic stabilization, especially inflation control, and continued managerial improvements are important for strengthening bank performance and the efficiency of financial intermediation.

Keywords: Efficiency, Deposit Money Bank, Macroeconomic condition, Nigeria.

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1. Introduction

A sound and efficient banking system is fundamental to economic development because banks mobilize savings, screen and allocate credit, facilitate payments, and transmit monetary policy to the real economy. In bank-based financial systems, inefficiency in financial intermediation can weaken credit allocation, raise the cost of funds, impair profitability, and reduce the resilience of the financial system. For this reason, the measurement of bank efficiency has become a central concern in financial economics, with frontier methods increasingly used to distinguish managerial inefficiency from random shocks and environmental conditions (**Berger & Humphrey, 1997**; **Berger & Mester, 1997**). While a large part of the literature concentrates on cost and technical efficiency, profit efficiency is especially important because it captures how effectively banks convert available intermediation opportunities into earnings under prevailing market conditions.

The Nigerian case makes this question especially salient. Deposit money banks remain the backbone of formal

financial intermediation in Nigeria, yet they operate in a macroeconomic environment marked by recurrent inflationary pressure, exchange-rate instability, regulatory adjustment, and uneven output growth. Recent official statistics underline the severity of these conditions: Nigeria's real GDP growth stood at 3.40% in 2024, while headline inflation rose to 34.80% in December 2024, reflecting a difficult operating environment for financial institutions. Such macroeconomic volatility can affect profit efficiency through multiple channels, including higher operating costs, changes in the real value of bank assets and liabilities, weaker loan quality, altered credit demand, and more difficult pricing decisions. The central motivation of this study, therefore, is that a bank may appear inefficient not only because of weak internal management, but also because adverse macroeconomic conditions constrain its ability to attain frontier profit levels.

Despite the breadth of the banking-efficiency literature, three gaps remain insufficiently addressed in relation to Nigeria. First, much of the empirical literature still privileges cost or technical efficiency over profit efficiency, even though profit efficiency is more closely aligned with the commercial objective of banks and can reveal losses associated with suboptimal pricing, output mix, and risk management (**Berger & Mester, 1997**; **Fitzpatrick & McQuinn, 2008**). Second, studies on Nigeria often focus either on bank-specific determinants of performance or on profitability models outside a frontier framework, making it difficult to separate pure inefficiency from environmental constraints. Third, even where macroeconomic variables are considered, they are rarely linked explicitly to frontier-based efficiency estimates in a dynamic setting. For example, recent Nigerian evidence confirms that inflation and regulatory conditions matter for banking efficiency, but the literature still provides limited evidence on profit efficiency specifically and on how macroeconomic conditions shape it over time (**Ojeyinka & Akinlo, 2021**; **Ige, Omoregie, & Olofin, 2025**). This paper addresses these gaps by estimating a translog stochastic profit frontier for fourteen licensed deposit money banks in Nigeria over 2011–2024 and then examining the macroeconomic determinants of the resulting efficiency scores using a dynamic system generalized method of moments estimator.

The contribution of the study is therefore twofold. Empirically, it provides updated evidence on the extent of profit inefficiency in Nigerian deposit money banks using a frontier framework tailored to bank intermediation. Analytically, it shows whether and to what extent macroeconomic conditions particularly inflation and output growth help explain variations in profit efficiency after controlling for persistence in bank performance. The paper is guided by two research questions: how profit-efficient are deposit money banks in Nigeria, and do macroeconomic conditions significantly influence that efficiency? By answering these questions, the study contributes to the literature on bank performance in emerging economies and offers policy-relevant evidence on why macroeconomic stabilization matters for the effectiveness of financial intermediation. The remainder of the paper is organized as follows. Section 2 reviews relevant conceptual, theoretical, and empirical literature. Section 3 presents methodology, model specification, and data. Section 4 reports and discusses the empirical findings, while the final section concludes with policy implications.

2. LITERATURE REVIEW

2.1 Conceptual Review

2.1.1 Profit Efficiency

Profit efficiency refers to the extent to which a bank achieves the maximum attainable profit, given input prices, output quantities, netputs, and the production technology available to it, after allowing for statistical noise. In the frontier literature, it is commonly interpreted as the proportion of potential profit actually realized by the bank relative to the best-practice frontier (**Berger & Mester, 1997**). A bank with a profit-efficiency score close to one is therefore operating near the frontier, whereas a lower score indicates forgone profit arising from inefficiency. Unlike cost efficiency, which focuses on minimizing expenditure for a given level of output, profit efficiency captures losses associated with weak pricing decisions, poor output mix, inadequate risk management, and suboptimal use of market opportunities. For studies concerned with the performance of commercial banks, this broader concept is especially valuable because it aligns more closely with the objective of profit-maximizing intermediation.

Profit efficiency is often regarded as a more comprehensive performance concept than cost or technical efficiency because it incorporates both the cost side and the revenue-generating capacity of the bank (**Fitzpatrick & McQuinn, 2008**). A bank may be cost-efficient yet still fail to maximize profit if it chooses an inferior asset portfolio, misprices loans and deposits, or does not respond effectively to changing market conditions. In this sense, profit efficiency is particularly appropriate for analysing deposit money banks in economies where macroeconomic volatility can alter both the cost of funds and the profitability of lending activities. More efficient banks are therefore expected to be more profitable, better capitalized, and more resilient to shocks (**Hughes & Mester, 2013**).

2.1.2 Macroeconomic factors

Inflation

Inflation refers to a sustained increase in the general price level over time and is one of the most important indicators of macroeconomic instability. For banks, inflation matters because it influences operating costs, the real value of assets and liabilities, interest-rate adjustments, and borrowers' repayment capacity. When inflation is high and volatile, banks may face higher wage and administrative expenses, greater uncertainty in pricing loans and deposits, and a deterioration in credit quality if borrowers' real incomes fall. These channels imply that inflation can reduce banking efficiency, although the sign and magnitude of the effect may depend on whether banks are able to anticipate inflation and adjust their pricing behaviour accordingly.

The empirical literature provides mixed but generally important evidence on the role of inflation in banking performance. **Mishkin (2013)** emphasizes the close relationship between inflation and money growth, while studies such as **Macharia (2013)** **and** **Trujillo-Ponce (2013)** suggest that rising inflation may weaken bank performance by increasing operating costs and complicating intermediation decisions. Other studies report weaker or statistically insignificant effects, indicating that the relationship may vary across institutional settings and policy environments. For this reason, inflation remains an appropriate macroeconomic variable in models of bank efficiency, especially in economies where price instability is persistent.

Gross Domestic Product (GDP)

Gross domestic product (GDP) is a standard indicator of aggregate economic activity and is widely used to capture the state of the macroeconomy. In the banking literature, GDP growth is important because stronger economic activity typically supports credit demand, improves business conditions, and reduces default risk, while weak growth or recession can depress lending opportunities and worsen loan performance. **Bolt et al. (2012)**, for example, show that macroeconomic downturns can affect bank profitability through loan losses, net interest income, and operating costs. As a result, GDP growth is commonly treated as a relevant environmental factor in studies of bank performance and efficiency.

The expected relationship between GDP growth and bank efficiency is generally positive, but not necessarily uniform across countries or periods. Higher growth can stimulate deposit mobilization, expand loan demand, and improve repayment performance, thereby enhancing banks' ability to operate efficiently. By contrast, sluggish growth can reduce business activity, increase credit risk, and make intermediation more costly (Adiga, Okechukwu, & Musa, 2020). Although some studies find GDP growth to be a useful predictor of firm and bank performance, others report insignificant effects, suggesting that broader institutional and macro-financial conditions may mediate the relationship.

2.2 Theoretical Framework

This study is anchored in the intermediation approach developed by **Sealey and Lindley (1977)**, which treats banks as financial intermediaries that transform borrowed funds into loans and other earning assets. Under this framework, the banking firm uses labour, capital, and deposit funds to produce intermediation services and income-generating assets. The theory is particularly appropriate for efficiency analysis because it provides a clear basis for identifying bank inputs and outputs in frontier models. In this view, deposits are treated as an input rather than an output because they are a source of loanable funds that must be mobilized, serviced, and transformed into assets.

Subsequent studies, including **Murray and White (1983)** and **Favero and Papi (1995)**, further developed this perspective by emphasizing the intermediary role of banks in collecting deposits and allocating them to loans and other earning assets. The intermediation approach has since been widely adopted in empirical banking studies because it fits the operational reality of commercial banks and aligns naturally with both stochastic frontier and data envelopment analysis frameworks. It is also well suited to the present study, which models profit efficiency using input prices, earning assets, and fixed netputs in a way that reflects how Nigerian deposit money banks generate profits through intermediation activities.

2.3 Empirical Review

The empirical literature on bank efficiency is large and methodologically diverse. Existing studies differ in at least three important respects: the efficiency concept examined (cost, technical, or profit efficiency), the estimation method employed (stochastic frontier analysis, data envelopment analysis, directional distance functions, and related approaches), and the explanatory variables emphasized (bank-specific, industry-specific, and macroeconomic factors). For the purpose of this study, the review below focuses on evidence that is most relevant to two questions: the extent to which banks operate below the profit frontier, and whether

macroeconomic conditions help explain observed efficiency outcomes.

Nasim, Nasir and Drowning (2025) examined the determinants of bank efficiency in developed (G7) and developing (E7) countries from 2001 to 2020. The study made use of the Data Envelopment Analysis to test for efficiency and the fixed effects, random effects, Panel fully modified least square and Generalized Methods of Moments to test for the determinants of banks efficiency while the sample size was 109 banks. The result showed that leverage, capital adequacy, monetary conditions, economic growth, price stability and exchange rate have substantial effect on bank efficiency.

Using the Stochastic Frontier analysis, **Ige, Omoregie, and Olofin (2025)** examined determinants of banking efficiency in Nigeria. The study utilized data from sixteen commercial banks covering 2006–2018. Findings showed that Nigerian banks were approximately 82% cost-efficient. Also, Inflation negatively affected efficiency while regulatory quality and asset quality improved efficiency. The study concluded that macroeconomic stability significantly enhances banking efficiency in Nigeria.

In addition to, **Takahashi and Vasconcelos (2024)** investigated the impact of Non Performing Loans on the Technical efficiency of banks in Brazil using the Directional Distance function method. The sample size covered the period 2003 to 2022 and data was collected from both public and private banks. The results showed that NPLs have negative impact on the efficiency of banks in Brazil.

Using the Data Envelopment Analysis and Logit & Tobit regression, **Ullah, Mojeed and Popp (2023)** further examined the influence of internal and external factors on the efficiency of banks in Pakistan. The sample covered seventeen commercial banks over the period 2011 to 2020. The results showed that corporate governance, ultimate global ownership and return on equity have statistically significant impact on banks' efficiency while the macroeconomic factors like interest rate, inflation and economic freedom show a negative and insignificant impact on the efficiency of banks.

In the same year, **O'Connel (2023)** looked at the effect of bank-specific, industry specific and macroeconomic determinants of banks profitability amongst domestic UK commercial banks using the Generalized Method of Moments and covering the period 1998 to 2018. The results showed that all bank specific factors except credit risk, have significant impact on banks profitability while for macroeconomic determinants, only interest rate and inflation rate have significant effect on banks' profitability but cyclical output was statistically insignificant.

On the other hand, **Ojeyinka and Akinlo (2021)** examined the cost efficiency of commercial banks in Nigeria by employing the Stochastic Frontier Analysis. The study sampled 15 commercial banks over the period 2006 to 2018. Price of labour, price of funds and price of capita were used as input while loans was used as output. The result of the SFA revealed that the overall average cost efficiency of banks in Nigeria is 78%, meaning that 22% of resources used by commercial banks are been wasted. Also, loan-to-deposit ratio, operating expenses as a percentage of total assets, loan to total asset and capitalisation ratio are major determinants of cost efficiency in Nigeria while the effects of return on assets, GDP growth and inflation on cost efficiency are inconsequential within the period of study.

In another region, **Linh (2020)** measured the efficiency of banks in 9 Asean countries by using an Input-Output non-parametric Data Envelopment Analysis method in the period 2013 to 2013 and with a sample of 130 banks across the selected countries. Equity, Deposits, Loans and operating expenses were used as inputs while Total Operating income was used as output. The result showed that the average overall efficiency of ASEAN commercial banks in the study period is 59.2%, which means that with constant output, banks can save up to 40.8% input during business operation. Thus, the efficiency of ASEAN commercial banks in the period of 2013 - 2017 is relatively low. This may be because the ASEAN commercial banking system has many shortcomings that have not been overcome after the crisis period of 2008-2012.

In the same year, **Safiullah and Shamsuddin (2020)** estimated the technical efficiency of Islamic and conventional banks from a sample of banks in 28 countries using the Stochastic Frontier Analysis. They made use of 188 banks in total and covered the period 2003 to 2014 and also three input and three output quantities. The inputs were deposit, labour and physical capital while outputs were the total amount of loans, other earning assets and non-interest income. The result of the SFA showed that conventional banks are more technically efficient than Islamic banks. This disparity in efficiency could be a result of their adherence to Shariah laws.

Taken together, the empirical literature suggests four broad conclusions. First, bank efficiency varies substantially across countries, periods, and estimation methods. Second, most studies still focus on technical or cost efficiency, even though profit efficiency may be more informative for evaluating commercial-bank performance.

Third, both internal and external factors matter, but the relative importance of macroeconomic variables differs across institutional contexts. Fourth, for Nigeria in particular, the evidence on frontier-based profit efficiency remains limited when compared with the larger body of work on cost efficiency and profitability. This leaves room for a study that estimates profit efficiency directly and then examines whether macroeconomic conditions, especially inflation and GDP growth, help explain the observed differences in efficiency over time.

3 Research Methodology

This study employs an ex-post facto research design based on an unbalanced panel of fourteen licensed deposit money banks in Nigeria over the period 2011–2024. Consistent with the intermediation approach, banks are modelled as institutions that use labour, capital, and funds to generate loans, other earning assets, and profit. The empirical strategy proceeds in two stages. In the first stage, a translog stochastic profit frontier is estimated in order to recover bank-level profit-efficiency scores while allowing for statistical noise and firm-specific inefficiency. In the second stage, the estimated efficiency scores are used as the dependent variable in a dynamic panel model estimated by two-step system generalized method of moments (system GMM) to examine whether macroeconomic conditions help explain variation in profit efficiency over time. This two-stage design is appropriate because it separates the measurement of frontier inefficiency from the analysis of its macroeconomic correlates, thereby providing a clearer interpretation of both bank-level performance and environmental effects.

3.1 Model Specification

3.1.1 Model for Profit Efficiency

The profit frontier is specified to measure the extent to which each bank approaches the maximum attainable profit conditional on observed prices, outputs, and fixed netputs. Following the stochastic frontier literature, the dependent variable is profit before tax, transformed to accommodate logarithmic specification, while the explanatory variables comprise three input prices, two variable outputs, and two fixed netputs. Specifically, the input-price vector includes the price of labour, the price of capital, and the price of funds; the output vector includes loans and advances and other earning assets; and the netput vector includes equity and fixed assets. The translog functional form is adopted because it is flexible, does not impose restrictive substitution patterns, and is widely used in banking studies to approximate the underlying profit technology. In the frontier specification, the composite error term is decomposed into a symmetric random error component and a one-sided inefficiency term, with the latter capturing shortfalls from the profit frontier.

$$Y_{it} = \beta X_{it} + V_{it} + U_{it} \quad (3.1)$$

where:

Y_{it} is total Profit in logarithm form of bank *i* in period *t*

X_{it} is a set of input and output prices

The profit function now becomes:

$$\pi^* = f(W, Q, Z) \quad (3.2)$$

where:

π^* is the profit function, W stands for input, Q stands for output and Z stands for netputs

Equation (3.19) is implemented as a stochastic profit frontier, not a conventional regression model. In this framework, the observed deviation of bank profit from the estimated frontier is decomposed into two parts: a symmetric random error term, which captures measurement error and other shocks outside managerial control, and a one-sided inefficiency term, which captures shortfalls from maximum attainable profit. The frontier approach is therefore preferable to an ordinary linear specification because it permits direct estimation of bank-specific profit inefficiency while retaining an explicit role for statistical noise.

$$In\pi_{it} = f(InW_{it}, InQ_{it}, InZ_{it;}\beta) + V_{it} - U_{it} \quad (3.3)$$

Empirically, the specification of Equation (3.3) requires one to assume a functional form. This study adapted the translog cost function which is specified as:

$$In(\pi_{it} + \theta + 1) = \propto_0 + \sum \propto_i InW_{it} + \sum \beta_i InQ_{it} + {}^1/_2 \sum\sum \propto_{ij} InW_{it}InW_{jt} + {}^1/_2 \sum\sum \beta_{ij} InQ_{it}InQ_{jt} + \sum\sum \gamma_{ij} InW_{it}InQ_{jt} + \sum \delta_i InZ_{it} + {}^1/_2 \sum\sum \delta_{ij} InZ_{it}InZ_{jt} + \sum\sum \eta_{ij} InZ_{it}InQ_{jt} + \sum \varphi_{ij} + InZ_{it}InW_{jt} + V_{it} - U_{it} \quad (3.4)$$

π is defined as profit before tax; θ is the absolute value of the minimum value of profit over all banks in the sample to avoid negative profit which is inappropriate for the logarithmic form. W is a vector of input prices which comprises of Price of labour, Price of Capital and Price of fund; Q is a vector of variable outputs; which comprises of Loans and advances and other earning assets while Z is a vector of fixed netputs which comprises of equity and fixed assets.

The unknown parameters are α, β, γ, δ, η and φ. α_0 is the constant term; α_i, β_i and δ_i are the first partial derivatives of the inputs, outputs and netputs respectively; α_{ij}, β_{ij} and

δ_{ij} are the own second partial derivatives while γ_{ij}, η_{ij} and φ_{ij} are the cross second derivatives, *(v_{it})* is the measurement error and (u_{it}) is the inefficiency term. In equation 3.4, the inefficiency term U_{it} is negative because inefficiency reduces profit.

3.1.2 Model for Macroeconomic determinants of Profit Efficiency

To examine the macroeconomic determinants of profit efficiency, the study estimates a dynamic panel model using the two-step system generalized method of moments estimator. This estimator is appropriate because profit efficiency is likely to be persistent over time, and the inclusion of a lagged dependent variable in a short panel can render conventional fixed-effects estimators biased. In addition, macroeconomic conditions may be correlated with unobserved bank-level heterogeneity, while reverse causality and simultaneity cannot be ruled out entirely. The system GMM framework addresses these concerns by combining equations in first differences and levels and by using internal instruments derived from lagged values of the endogenous or predetermined variables. The validity of the specification is assessed using the Hansen and Sargan tests of over-identifying restrictions and the Arellano–Bond tests for first- and second-order serial correlation. The instrument count is also kept parsimonious relative to the cross-sectional dimension in order to reduce the risk of instrument proliferation.

The functional relationship of the variables is as follows:

$$PE_{it} = f(GDP_{it}, INF_{it}) \quad (3.5)$$

Where

GDP_{it}, INF_{it} (economic growth and inflation) are the macro economic factors that can affect the profit efficiency of deposit money banks *i* over period *t. t* is the time series indices of the scope that the study will cover; 2011 to 2024, (14 years) and *i* is the domain that contains the cross-sectional characteristics of the data (deposit money banks under investigation).

Where PE_{it} is profit efficiency (obtained from the SFA) of deposit money bank *i* over period *t*;

GDP_{it}, INF_{it} (economic growth and inflation) are the macro economic factors that can affect the profit efficiency of deposit money banks *i* over period *t. t* is the time series indices of the scope that the study will cover; 2011 to 2024, (14 years) and *i* is the domain that contains the cross-sectional characteristics of the data (deposit money banks under investigation).

The following dynamic panel specification is estimated to examine the relationship between macroeconomic conditions and deposit money banks' profit efficiency in Nigeria. Profit efficiency is regressed on its own lag to capture persistence and on the selected macroeconomic variables to identify whether changes in the external environment help explain movements in bank-level efficiency over time.

$$PE_{it} = \rho + \omega CE_{i,t-1} + \beta GDP_{it} + \gamma INF_{it} \sum_{j=1}^{k} \delta_j X_{it} + \mu_{it} \quad (3.6)$$

$$j = 1 \ldots\ldots\ldots, k; i = 1 \ldots\ldots\ldots\ldots n; t = 1 \ldots\ldots\ldots\ldots T$$

4. Results and discussion

4.1.1 Profit Efficiency Parameter Estimation using SFA

This subsection presents the parameter estimates of the translog stochastic profit frontier. The dependent variable is profit before tax, adjusted to allow logarithmic transformation in the presence of negative values. The explanatory variables comprise three input prices price of labour, price of capital, and price of funds two variable outputs loans and advances, and other earning assets and two fixed netputs equity and fixed assets. Following standard practice in profit-frontier estimation, profit and price variables are normalized by the price of capital in order to satisfy homogeneity restrictions and improve comparability across banks. All variables entering the frontier are expressed in logarithms, and the likelihood-ratio test is used to assess whether inefficiency is present in the data.

Table 4.1: Stochastic Frontier Analysis for Profit Efficiency Model

Variables	SFA - Profit Efficiency Model		
	Coef.	*std-error*	*t-ratio*
Constant	143.51***	3.7926	37.8400
W_1	31.663***	7.4926	4.2259
W_2	45.392***	6.5830	6.8953
$W_1 Q_1$	3.4110***	0.9283	3.6745
$^1/_2 W_1{}^2$	-0.6448	0.8829	-0.7303

$^1/_2 W_2{}^2$	5.5883**	1.9936	2.8032
Q_1	7.1541	6.5001	1.1006
Q_2	72.951***	4.7593	15.3280
Q_1Q_2	8.628***	3.0098	2.8665
$^1/_2 Q_1{}^2$	0.0003	0.8413	0.0003
$^1/_2 Q_2{}^2$	1.7185	2.4785	0.6933
Z_1	-77.55***	2.0210	-38.3703
Z_2	-14.57***	1.5649	-9.3095
Z_1Z_2	12.717***	2.5586	4.9702
$^1/_2 Z_1{}^2$	6.3857	3.9786	1.6050
$^1/_2 Z_2{}^2$	-0.0044	0.1315	-0.0335
W_1W_2	1.0344	2.0140	0.5136
W_1Q_2	0.2158	0.9876	0.2185
W_2Q_1	4.5114***	1.1832	3.8128
W_2Q_2	2.2179	1.8632	1.1903
Z_1Q_1	-5.891***	1.7510	-3.3644
Z_2Q_1	2.2407**	1.0506	2.1328
Z_1Q_2	-2.4588	2.9258	-0.8404
Z_2Q_2	-8.408***	1.0241	-8.2104
Z_1W_1	-1.3819	1.4327	-0.9645
Z_1W_2	-5.8422**	2.6094	-2.2389
Z_2W_1	-4.723***	0.9370	-5.0402
Z_2W_2	-3.225***	1.1519	-2.7995
sigma-squared	0.9266	0.1184	7.8276
Gamma	0.6699	0.2715	2.4671
Log likelihood	-192.860***		
Likelihood ratio	8.821		

t-ratio > 2.576, 1.96 and 1.64 denote 1%, 5% and 10% level of significance.
Source: Author's Computation 2025.

Table 4.1 reports the estimated translog stochastic profit frontier. Because a translog specification contains first-order, squared, and interaction terms, individual coefficients should not be interpreted in isolation as constant marginal effects. Instead, the main value of the table is to show whether the estimated frontier is statistically well defined and whether the data support the presence of profit inefficiency. The results indicate that several first-order and interaction terms are statistically significant, suggesting meaningful nonlinearity in the profit technology of Nigerian deposit money banks. In substantive terms, the estimates are consistent with the view that profit performance depends jointly on factor prices, balance-sheet composition, and the interaction between outputs and fixed netputs rather than on any single component alone.

A number of coefficients associated with input prices, outputs, and interaction terms are statistically significant, indicating that the profit frontier is not adequately represented by a simple linear structure. In particular, the significance of several cross terms suggests that the relationship between profitability and bank characteristics is conditional on the broader composition of inputs and assets. This is one reason the translog form is preferable

in the present context. Rather than treating each coefficient as a stand-alone elasticity, the appropriate interpretation is that banks' ability to attain frontier profit levels depends on the combined configuration of labour costs, funding costs, capital intensity, loan activity, other earning assets, and balance-sheet structure.

A more detailed reading of Table 4.1 suggests that some first-order terms associated with outputs and several interaction terms involving netputs and input prices are statistically significant. This pattern reinforces two substantive points. First, profit generation in Nigerian deposit money banks depends on the joint configuration of balance-sheet structure, funding costs, and earning assets rather than on isolated variables taken one at a time. Second, the presence of significant interaction terms implies that the effect of a given factor on profit is conditional on the levels of other factors, which is precisely the type of nonlinearity the translog specification is designed to capture. Accordingly, the table is most usefully interpreted as evidence of a complex but economically meaningful profit frontier rather than as a set of simple marginal effects.

The lower panel of Table 4.1 provides the key diagnostics for the frontier model. The estimated gamma of 0.6699 indicates that approximately 66.99% of the composite error variance is attributable to inefficiency rather than random noise, which is consistent with the presence of economically meaningful profit inefficiency in the sample. In addition, the likelihood-ratio statistic supports rejection of the null hypothesis of no inefficiency, indicating that the stochastic frontier specification is preferred to a standard regression model. Taken together, these diagnostics justify the use of a frontier framework and support the subsequent analysis of bank-level efficiency scores.

4.1.2 Trends of the deposit money banks Efficiency Scores

To gain more insights into the specifics of the banks estimated cost and profit efficiency scores during the period 2011 – 2024. The estimated average profit efficiency scores of the banks are presented below:

Table 4.2: Trends of the Banks Profit Efficiency Scores

Year	Nigeria
2011	0.828
2012	0.814
2013	0.817
2014	0.819
2015	0.821
2016	0.822
2017	0.820
2018	0.816
2019	0.817
2020	0.812
2021	0.816
2022	0.821
2023	0.826
2024	0.831
Ave.	0.820

Table 4.2 shows that average profit efficiency in the Nigerian banking sample remained relatively stable over the study period, fluctuating within a narrow band around the sample mean of 0.820. This implies that, on average, banks operated at about 82% of the estimated profit frontier and therefore forfeited roughly 18% of potential profit to inefficiency. The series does not display a persistent downward trend. Instead, it shows mild variation over time, with a softening around 2020 and a subsequent recovery in 2021–2024. The decline in 2020 is plausibly consistent with the disruption associated with the COVID-19 shock, while the later improvement may reflect the normalization of business conditions, changes in interest margins, and adjustments in banks' operating models. Overall, however, the temporal pattern suggests more persistence than volatility in profit efficiency.

Table 4.3: Profit Efficiency and Macroeconomic Factors

Dependent Variable: Profit Efficiency (PE)	(2) SGMM2-Nigeria
Lag of Profit Efficiency (L.PE)	0.6176*** (0.0938) [0.0000]
Gross Domestic Product (GDP)	1.4329 (1.5234) [0.3469]
Inflation (INF)	-0.1587** (0.0683) [0.0201]
Constant	4.4853 (33.1247) [0.8923]
Observations	126
Number of Bank	14
Sargan test	1.06 [0.589]
Hansen test	1.464 [0.481]
AR(1) test stat.	-2.129 [0.049]
AR(2) test stat.	-1.444 [0.149]
No. of Instruments	6
Wald Chi2 test	64.85 [0.000]

*Source: Author's Computation 2025. Note: *** represents 1% significance level (P<0.01), ** denotes 5% significance level (P<0.05), * symbolizes 10% significance level (P<0.10). Standard errors in parentheses ( ) and Probability values in square bracket*

Table 4.3 reports the dynamic panel estimates for the macroeconomic determinants of profit efficiency. The lagged dependent variable is positive and highly significant, indicating strong persistence in profit efficiency over time. This result suggests that banks that perform relatively efficiently in one period tend to remain relatively efficient in subsequent periods, which is consistent with the inclusion of a dynamic specification. The estimated coefficient also implies that adjustments in efficiency are gradual rather than instantaneous.

The coefficient GDP growth is positive but statistically insignificant. The sign is consistent with the expectation that stronger aggregate economic activity may improve intermediation conditions and support bank efficiency, but the estimate does not provide sufficient evidence to conclude that GDP growth had an independent effect on profit efficiency in this sample once persistence and inflation are taken into account. A plausible interpretation is that the transmission from output growth to bank profit efficiency is indirect, heterogeneous across banks, or overshadowed by other macro-financial conditions.

Inflation, by contrast, enters with a negative and statistically significant coefficient at the 5% level. This finding indicates that higher inflation is associated with lower profit efficiency among Nigerian deposit money banks. The result is economically plausible: inflation can raise operating costs, complicate pricing decisions, erode the real value of financial claims, and weaken borrowers' repayment capacity, all of which may move banks farther away from the profit frontier. The estimated coefficient should therefore be interpreted as evidence that macroeconomic instability, especially price instability, is an important environmental constraint on banking efficiency.

The post-estimation diagnostics support the adequacy of the dynamic panel specification. The Hansen and Sargan tests are both statistically insignificant, so the null hypothesis that the instruments are valid cannot be rejected. The Arellano–Bond test detects first-order serial

correlation in first differences, which is expected in dynamic panel models, while the absence of second-order serial correlation supports the consistency of the moment conditions. In addition, the number of instruments remains low relative to the number of banks, reducing concerns about instrument proliferation. Taken together, these diagnostics suggest that the system GMM estimates are reasonably robust.

Finally, the Wald statistic indicates that the regressors are jointly significant. The null hypothesis that the included macroeconomic variables have no explanatory power for profit efficiency is therefore rejected. Although GDP growth is not individually significant, the joint test shows that the macroeconomic environment matters for the evolution of profit efficiency in Nigerian deposit money banks, thereby reinforcing the broader argument of the paper.

4.2 Discussion of Findings

4.2.1 Profit Efficiency

The findings indicate that Nigerian deposit money banks are profit-inefficient on average, with a mean efficiency score of approximately 0.820. In practical terms, this implies that the sample banks realized about 82% of attainable profit and therefore lost roughly 18% of potential profit to inefficiency. This result is economically meaningful because it suggests that profitability shortfalls cannot be explained solely by random shocks; rather, they also reflect systematic departures from best-practice performance. The finding is broadly consistent with prior frontier studies that report the presence of non-trivial profit inefficiency in banking systems, including evidence from Nigeria and other emerging and developed markets. It also reinforces the relevance of focusing on profit efficiency, since banks may remain operational while still failing to exploit available profit opportunities fully.

4.2.2 Effect of Macroeconomic Factors on the Profit Efficiency of Deposit Money Banks

With respect to macroeconomic determinants, the results suggest that inflation is the more consequential variable for profit efficiency in Nigeria. The negative and significant coefficient on inflation accords with studies that associate macroeconomic instability with weaker banking performance, higher intermediation costs, and reduced efficiency. By contrast, GDP growth does not exert an independently significant effect in the dynamic specification. This does not imply that aggregate economic activity is irrelevant; rather, it suggests that, within the sample period, its effect on profit efficiency may have been indirect, episodic, or dominated by stronger inflationary pressures. The broader implication is that macroeconomic conditions matter for bank efficiency, but not all components of the macroeconomic environment affect banks with equal force or through equally direct channels.

Overall, the evidence points to a dual interpretation of banking performance in Nigeria. On the one hand, part of the observed gap from the profit frontier reflects bank-level inefficiency, which may be addressed through better managerial practices, balance-sheet optimization, and improved pricing decisions. On the other hand, the significant role of inflation indicates that the external macroeconomic environment also constrains banks' ability to achieve frontier profit levels. The results therefore support a policy perspective in which bank-level reforms and macroeconomic stabilization are complementary rather than substitutes in efforts to strengthen the efficiency of financial intermediation.

More broadly, the Wald test confirms that the macroeconomic variables are jointly relevant for explaining profit efficiency, even though only inflation is individually significant in the preferred specification. This result is consistent with the wider literature showing that banking performance is shaped not only by internal bank characteristics but also by external macroeconomic conditions. The finding is therefore in line with studies such as Eissa et al. (2018), which report that macroeconomic variables collectively matter for banking outcomes, while also underscoring that the strength and significance of individual channels may differ across countries, time periods, and model specifications.

5 Summary and Conclusion

This paper examined the profit efficiency of deposit money banks in Nigeria and investigated whether macroeconomic conditions help explain the observed variation in profit efficiency over time. Using panel data for fourteen licensed deposit money banks over 2011–2024, the study employed a two-stage empirical strategy. In the first stage, a translog stochastic profit frontier was estimated to recover bank-level efficiency scores. In the second stage, the estimated scores were modelled as a function of macroeconomic conditions using a dynamic system generalized method of moments framework. This design made it possible to distinguish the measurement of profit inefficiency from the analysis of its macroeconomic correlates.

The empirical results yield three main conclusions. First, Nigerian deposit money banks operate below the estimated profit frontier, with an average profit efficiency score of 0.820, implying that approximately 18% of attainable profit is lost to inefficiency. Second, the efficiency series is relatively stable over time, although there is a mild decline around 2020 followed by recovery in subsequent years. Third, the dynamic panel estimates

show that profit efficiency is persistent and that inflation exerts a negative and statistically significant effect on profit efficiency, whereas GDP growth does not have an independently significant effect in the preferred specification. Nevertheless, the joint significance test indicates that macroeconomic conditions matter for the evolution of bank profit efficiency in Nigeria.

The study therefore concludes that the performance of deposit money banks in Nigeria reflects both internal inefficiency and external macroeconomic constraints. The presence of substantial profit inefficiency suggests that banks are not fully converting available intermediation opportunities into earnings. At the same time, the adverse effect of inflation indicates that macroeconomic instability weakens banks' ability to operate near the profit frontier. The paper thus contributes to the literature by providing frontier-based evidence on profit inefficiency in Nigeria and by showing that the macroeconomic environment, particularly inflation, is an important determinant of efficiency outcomes.

From a policy perspective, the findings imply that improving banking efficiency in Nigeria requires both micro-level and macro-level actions. At the bank level, managers should strengthen cost control, asset-liability management, risk pricing, and the allocation of earning assets in order to reduce avoidable profit losses. At the policy level, macroeconomic stabilization, especially credible measures to contain inflation remains essential for improving the operating environment within which banks intermediate funds. These results should, however, be interpreted in light of some limitations. The analysis focuses on a restricted set of macroeconomic variables and on licensed deposit money banks only. Future research could extend the framework by incorporating additional macro-financial variables, alternative efficiency specifications, and comparative evidence across African banking systems.

References

Berger, A. N., & Humphrey, D. B. (1997). Efficiency of financial institutions: International survey and directions for future research. European Journal of Operational Research, 98(2), 175–212.

Berger, A. N., & Mester, L. J. (1997). Inside the black box: What explains differences in the efficiencies of financial institutions? Journal of Banking & Finance, 21(7), 895–947.

Bolt, W., de Haan, L., Hoeberichts, M., van Oordt, M. R. C., & Swank, J. (2012). Bank profitability during recessions. Journal of Banking & Finance, 36(9), 2552–2564.

Eissa, A., Mosab, I., Najib, H. and Faozi, A. (2018). Bank-specific and macro-economic determinants of profitability of Indian commercial banks: A panel data approach. *Cogent Economics and Finance Journal, 6*(1), 1-21

Fitzpatrick, T., & McQuinn, K. (2008). Measuring bank profit efficiency. Applied Financial Economics, 18(1), 1–8.

Hughes, J. P. & Mester, L. J. (2013) A Primer on Market Discipline and Governance of Financial Institutions for those in a State of Shocked Disbelief,in Efficiency and Productivity Growth: Modelling in the Financial Services Industry. (ed F. Pasiouras), John Wiley & Sons, Ltd, Chichester, UK. doi: 10.1002/9781118541531.

Ige, P. A., Omoregie, O. K., & Olofin, S. A. (2025). Determinants of banks and financial system efficiency in Nigeria: A stochastic frontier approach (SFA). *Asian Journal of Economics, Business and Accounting, 25*(3), 77–92.

Kumbhakar, S. C., & Lovell. A.K. (2000). Stochastic frontier analysis: an econometric approach. Cambridge University Press, Cambridge.

Leamer, E.E. (2009) Gross Domestic Product. In: Leamer, E.E., Ed., Macroeconomic Patterns and Stories, Springer, Berlin, 19-38.

Lee, C., & Huang, T. (2017). Cost efficiency and technological gap in Western European banks : a stochastic metafrontier analysis. *International Review of Economics and Finance 48*(2017), 161–178. https://doi.org/10.1016/j.iref.2016.12.003

Linh, T. D. (2020). Non-parametric approach to measuring the efficiency of banking sectors crediting agribusiness in ASEAN countries. E3S Web of Conferences, 175, 13031.

Macharia, E. (2013). The effects of global financial crisis on the financial performance of commercial banks offering mortgage finance in Kenya. International Journal of Social Sciences and Entrepreneurship, 1(1), 688–701.

Mishkin, F.S. (2013) The Economics of Money, Banking, and Financial Markets. 10th Edition, Pearson Education, New York.

Murray, J. D., & White, R. W. (1983). Economies of scale and economies of scope in multiproduct financial institutions: A study of British Columbia credit unions. The Journal of Finance, 38(3), 887–902.

Nasim, A., Nasir, M. A., & Downing, G. (2025). Determinants of bank efficiency in developed (G7) and developing (E7) countries: Role of regulatory and economic environment. Review

of Quantitative Finance and Accounting, 65, 257–294.

O'Connell, M. (2023). Bank-specific, industry-specific and macroeconomic determinants of bank profitability: Evidence from the UK. Studies in Economics and Finance, 40(1), 155–174.

Ojeyinka, T. A., & Akinlo, A. E. (2021). Does bank size affect efficiency ? evidence from commercial banks in Nigeria. *Ilorin Journal of Economic Policy 8*(1), 79–100.

Ravikumar, U &Basavaraj, C. (2019). Efficiency analysis of selected private sector banks in india using Data Envelopment Analysis. *EPRA International Journal of Multidisciplinary Research*. *5*(8), 30-37.

Robin, I., Salim, R., & Bloch, H. (2018). Cost efficiency in Bangladesh banking: does financial reformmatter?*AppliedEconomics*,*50*(8),891–904. https://doi.org/10.1080/00036846.2017.1346361

Sadono, E. D. (2017). Efficiency of islamic rural banks (BPRS) in East Java province , Indonesia *Tazkia Islamic Finance and Business Review*, *11*(1), 1–14

Safiullah, M., & Shamsuddin, A. (2020). Technical efficiency of conventional and Islamic banks. Journal of King Abdulaziz University: Islamic Economics, 33(1), 3–20

Salim, R. Arjomadi, Amir & Dakpo (2017). Banks' efficiency and credit risk analysis using by-production approach : the case of Iranian banks. *Applied Economics , Taylor & Francis Journals, 49*(30), 2974-2988.

Sanyaolu, W. A., Adejumo, B. T., & Kadiri. I. (2020). Board diligence and financial performance: evidence from Nigerian deposit money banks. *Copernican Journal of Finance and Accounting, 9*(3), 145-160.

Sealey C.W. and J. T. Lindley (1977). Inputs, output and a theory of production and cost at depository financial institutions, *Journal of Finance*, *32*(1), 1251-1266.

Sopan, J. (2021). Macroeconomic variables and firm performance. *Journal of Economic Policy Studies, 14*(2), 88–102.

Syed, M. (2018). Banks' capital buffers, risk, and efficiency in emerging economies: are they counter-cyclical? *Eurasian Economic Review*, *9*(4),407-492. https://doi.org/10.1007/s40822-018-0121-5

Trujillo-Ponce, A. (2013). What determines the profitability of banks? Evidence from Spain. Accounting & Finance, 53(2), 561–586.

Ullah, S., Majeed, A., & Popp, J. (2023). Determinants of bank's efficiency in an emerging economy: A data envelopment analysis approach. PLOS ONE, 18(3), e0281663.

Yanga, B. (2020). Effect of Credit Risk on the Efficiency of Banks in Member Countries of the Economic and Monetary Community of Central Africa (Cemac). *Journal of Economics and Development Studies 8*(4), 38–49. https://doi.org/10.15640/jeds.v8n4a4