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Factors affecting technical efficiency among selected universal banks in the Philippines

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ABSTRACT

The banking sector is the backbone of the financial system, playing a pivotal role in fostering socioeconomic development. In an increasingly competitive global market, understanding and improving bank efficiency is essential for sustainable economic growth. This study examines the factors influencing the technical efficiency of universal banks in the Philippines from 2016 to 2021. Using a two-stage analysis, technical efficiency scores were computed through Data Envelopment Analysis (DEA), followed by a Tobit regression to determine the impact of key factors: capital adequacy, loan quality, inflation rate, and real GDP rate. The findings reveal that among these factors, only loan quality significantly affects technical efficiency, with higher loan quality ratios negatively impacting efficiency due to increased default risk. The results highlight the need for universal banks to optimize their loan portfolios while maintaining robust credit risk management. These insights provide practical implications for policymakers and banking practitioners to enhance operational efficiency and resilience in the Philippine banking sector.

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1. INTRODUCTION

The banking sector serves as the backbone of the financial system, playing a vital role in fostering economic growth and development (Alber et al., 2019). As critical financial intermediaries, banks are essential for channeling funds, supporting business operations, and promoting investment and consumption (Hamid et al., 2017). However, the increasing contestability of international markets has created heightened competition, compelling banks to focus on improving efficiency to remain viable and competitive (Abd Karim, 2001; Alomari et al., 2020). Efficiency within banks is not merely about minimizing costs but also about maximizing profitability and ensuring resilience against risks while maintaining quality services for consumers (Andries & Ursu, 2016).

Bank efficiency is a central focus in financial literature as it determines an institution's ability to withstand competitive pressures and adapt to structural changes within the industry (Chen, 2002). For banks, achieving technical efficiency implies an optimized utilization of resources to maximize output, which is crucial for stability and sustainable development (Thao & Thuy, 2015). Particularly in emerging economies like the Philippines, efficient banking operations are critical to supporting the nation's broader economic goals. Despite the modest growth of the Philippine banking system during the COVID-19 pandemic, the sector experienced a decline in annualized net profits, signaling underlying inefficiencies (Bangko Sentral ng Pilipinas, 2021). Fitch Ratings highlighted concerns about rising bad loans and weakening profitability, while the International Monetary Fund (IMF) cautioned against potential systemic solvency risks (Business World, 2021; Noble, 2021). These challenges emphasize the importance of assessing and enhancing technical efficiency within the banking sector to ensure stability and resilience (Diallo, 2018; Yadav, 2015).

Past research on bank efficiency has largely concentrated on financial ratios and the analysis of scale and scope efficiencies. While these approaches provide valuable insights, they often overlook technical efficiency—a critical dimension that reflects how banks manage their operational inputs and outputs (Molyneux, Altunbas, Moore, & Gardener, 2001). Technical efficiency is especially significant for central banks and regulators as it enables them to assess the effectiveness of policy interventions and the overall health of the banking sector (Leykun, 2018). However, there is limited empirical research examining the technical efficiency of Philippine banks, particularly in the context of key determinants such as capital adequacy, loan quality, inflation rate, and real GDP growth rate.

The study anchors primarily on the intermediation theory, which serves as a foundational framework for analyzing bank efficiency, particularly in the context of universal banks. This theory posits that banks act as intermediaries by mobilizing funds from depositors and channeling them to borrowers, thereby facilitating economic activity and growth (Sealey & Lindley, 1977). The theory provides insights into resource allocation and operational optimization. Recent advancements in the application of intermediation theory emphasize the role of technological innovation and regulatory frameworks in shaping bank performance, especially in emerging markets like the Philippines (Leykun, 2018; Erena et al., 2021). However, critics argue that the intermediation model oversimplifies the complexity of modern banking, particularly in its treatment of non-interest income activities and risk management strategies. In the Philippine context, where banks play a pivotal role in supporting small and medium enterprises (SMEs) and driving financial inclusion, this theory underscores the importance of enhancing efficiency to address systemic vulnerabilities and promote economic stability.

Moreover, the Resource-Based View (RBV) offers a complementary perspective by emphasizing the internal capabilities of banks as critical determinants of their efficiency and competitiveness (Barney, 1991). According to RBV, banks with unique, valuable, and difficult-to-imitate resources—such as robust risk management systems, skilled human capital, and technological infrastructure—are better positioned to achieve higher levels of technical efficiency. This theory is particularly relevant in the Philippine banking sector, where disparities in resource endowments across banks contribute to varying efficiency levels (Diallo, 2018). Integrating RBV with insights from the Intermediation Theory provides a more comprehensive understanding of efficiency, acknowledging both external market dynamics and internal organizational capabilities. Nonetheless, one limitation of RBV is its limited focus on external macroeconomic factors, such as inflation and GDP growth, which significantly impact bank operations in developing economies like the Philippines. Addressing these gaps requires a holistic approach that incorporates both theories while accounting for the unique challenges and opportunities in the Philippine banking landscape.

This study addresses this gap by investigating the factors affecting the technical efficiency of selected universal banks in the Philippines from 2016 to 2021. The focus on universal banks is warranted due to their significant role in the financial ecosystem, serving as primary channels for capital allocation and economic growth. Specifically, this study aims to achieve two objectives: (1) to measure the technical efficiency scores of universal banks during the study period using Data

Envelopment Analysis (DEA), and (2) to analyze the influence of factors such as Capital Adequacy, Loan Quality, Inflation Rate, and Real GDP Growth Rate on bank efficiency using Tobit regression. By addressing these objectives, this research contributes to the existing body of knowledge and provides actionable insights for improving the performance and resilience of the Philippine banking sector.

2. RESEARCH METHOD

2.1 Unit of Analysis

Universal Banks (UBs) in the Philippines are the subject of the study. There are 24 total UBs operating during the conduct of the study. Due to data availability, only 12 UBs are being considered. The 12 banks are as follows with assigned code number:

Table 1. *List of bank DMUs*

Code	Bank Name
1	Union Bank of the Philippines
2	Security Bank Corporation
3	Rizal Commercial Banking Corporation
4	Philippine National Bank
5	Metropolitan Bank and Trust Company
6	East West Banking Corporation
7	Landbank of the Philippines
8	Development Bank of the Philippines
9	Bank of the Philippine Islands
10	BDO Unibank Inc.
11	Chinabank Inc.
12	Asia United Bank

**Authors Coding*

2.2. Design and Procedure

This study employs a quantitative research design utilizing a two-stage analysis, combining non-parametric and parametric approaches. The first stage measures the technical efficiency scores of banks using Data Envelopment Analysis (DEA), while the second stage applies Tobit Regression to analyze the factors influencing technical efficiency. DEA is selected due to its ability to handle multiple input-output relationships and its flexibility in assessing the relative efficiency of decision-making units (DMUs) without requiring explicit assumptions about the functional form of the production process (Farrell, 1957; Berger & Humphrey, 1997). DEA is particularly suited for the banking sector as it allows a granular evaluation of resource utilization and output generation, accommodating variations in operational scales. The Tobit regression is employed in the second stage due to the censored nature of efficiency scores, which range between 0 and 1, making traditional regression techniques inappropriate (McDonald & Moffitt, 1980). This combination ensures robust and reliable results in identifying the determinants of bank efficiency.

All data in the study are secondary, covering selected Universal Banks in the Philippines from 2016 to 2021. Based on data gathering, only 12 banks are being considered due to data availability. Data on macroeconomic variables are taken from World Bank (for Inflation Rate and Real GDP Growth Rate) and for bank-related variables are from the Respective Bank website (Bank Annual Report).

The intermediation approach guided the selection of input and output variables for DEA, as it emphasizes the intermediary role of banks in mobilizing and allocating funds. Input variables include physical capital, labor, and loanable funds, representing essential resources that banks deploy in their operations. Output variables consist of net interest income and non-interest income, reflecting the financial outcomes of a bank's intermediation activities (Sealey & Lindley, 1977; Singh & Malik, 2018).

This selection aligns with established literature and ensures that the variables capture the core activities contributing to technical efficiency. While there is no universal consensus on the ideal set of variables for DEA, the chosen inputs and outputs were cross-referenced with similar studies to enhance validity and comparability.

2.3 Data Analysis

This study employs a two-stage analysis. Data Envelopment Analysis (DEA) is used for the first estimation stage. In performing data envelopment analysis, input and output variables are used. Determining the variables follows the intermediation approach. Berger and Humphrey (1997) stated that to measure the relative efficiency of a bank with all the other banks, the intermediation approach is suitable. Following the framework of Singh and Malik (2018), the following variables are used: (a) Input Variables: physical capital, labor, and loanable funds; (b) Output Variables: net interest income and non-interest income. Literature suggests that there needs to be clarity concerning the set of inputs and outputs to be used; there has yet to be a consensus concerning the choice of variables used for calculating the technical efficiency scores (Singh & Malik, 2018).

For Stage 2 estimation, Tobit Regression is used. Tobit Regression is one of the widely applied techniques in assessing the impact of determinants on the technical efficiency of the banking industry (Sharma et al., 2013). The dependent variable used are the technical efficiency scores derived using DEA while the independent variables are as follows*: capital adequacy ratio* refers to a bank's ability to pay its debts if borrowers are unable to pay back the money they have borrowed from the bank; *loan quality (loans to total asset ratio)* refers to the total loans outstanding as a percentage of total assets; *inflation rate* refers to a rate of increase in prices over a given period; and *real GDP growth rate* is a measure of economic growth, as expressed by Gross Domestic Product (GDP), from one period to another, adjusted for inflation or deflation (Akmal & Saleem, 2008).The logic for using Tobit regression in this study is that technical efficiency scores are between 0 and 1, and censored regression should be used (Singh & Fida, 2015).

3. RESULTS AND DISCUSSIONS

3.1. DEA Efficiency Results

Table 2 presents the summary result of the technical efficiency of 12 banks from 2016 to 2021. It is shown that Banks 3, 4, and 11 (refer to Table 1 for bank coding) are inefficient under the VRS condition, while Banks 3, 4, 7, 8, 9, 10, 11, and 12 are inefficient under the CRS condition. An efficiency scores equal to 1 means that the bank is technically efficient. It implies that the bank is

Table 2. *Efficiency summary results*

Bank	CRSTE	VRSTE	Scale	Returns to Scale	Peer Bank/s
1	1	1	1		1
2	1	1	1		2
3	0.756	0.799	0.946	DRS	5, 6, 10
4	0.685	0.757	0.905	DRS	5, 6
5	1	1	1		5
6	1	1	1		6
7	0.986	1	0.986	DRS	7
8	0.956	1	0.956	IRS	8
9	0.873	1	0.873	DRS	9
10	0.679	1	0.679	DRS	10
11	0.613	0.729	0.841	DRS	6, 7, 9, 10
12	0.804	1	0.804	IRS	12
Mean	0.863	0.94	0.916		

No. of Banks Efficient = **9**
No. of Banks Inefficient = **3**
Legend:
CRSTE (Constant Returns to Scale Technical Efficiency)
VRSTE (Variable Returns to Scale Technical Efficiency)
Scale (VRSTE/CRSTE)
IRS and DRS are Increasing and Decreasing Returns to Scale

maximizing the output at given inputs. The VRSTE result also indicates that, on average, commercial banks can still increase their efficiency by up to 6%. Since Banks 3, 4, and 11 are inefficient in this model, their efficiency can be improved by following the operating practices and policies of their corresponding peer/s as presented in same table. Moreover, under the scale efficiency values (which determines whether the bank is operating at a full scale or not), Bank 10 operates at the lowest scale (0.679), tagged as the least scale efficient. In this case, Bank 10 can increase its efficiency by reducing the inputs it employs since it operates under decreasing returns to scale (DRS). While Banks 8 and 12 can improve their scale efficiency by increasing the amount of their inputs (as per model specification) since the two operate under increasing returns to scale (IRS).

Table 3 presents the Malmquist Index of Productivity Changes, providing a detailed assessment of Total Factor Productivity (TFP) changes for the selected universal banks in the Philippines from 2017 to 2021. An index value greater than 1 indicates an improvement in productivity, while a value less than 1 signals a decline. The results indicate an overall 7.1% growth in TFP across the five-year period, signifying positive advancements in the banking sector's efficiency. This growth is attributed to consistent improvements in efficiency change (2.3%), technical efficiency change (4.7%), pure efficiency change (1.3%), and scale efficiency change (1.0%). These dimensions highlight a generally progressive trend in operational performance and resource utilization by the banks during the study period.

Analyzing year-on-year changes, 2017 exhibited the highest technical efficiency growth (1.147), suggesting that advancements in technological capability significantly contributed to productivity during this period. Similarly, scale efficiency peaked in 2020 (1.065), implying an optimal utilization of operational scale during this year. Pure efficiency, a measure of managerial effectiveness, reached its highest level in 2021 (1.054), indicating continuous refinement in decision-making processes. Meanwhile, the year 2020 stands out as the period with the highest TFP growth rate at 16.5%, reflecting the banks' robust adaptive measures during a challenging global economic environment. This exceptional performance aligns with notable improvements in efficiency change (10.8%), technical efficiency change (5.2%), and scale efficiency change (6.5%). These findings suggest that, despite the economic disruptions caused by the COVID-19 pandemic, the banks successfully leveraged technological advancements and operational strategies to sustain productivity gains.

Table 3. *Annual productivity change*

Year	Effch	Tech	PEch	SEch	TFPch
2017	0.998	1.147	0.997	1.001	1.145
2018	1.060	1.013	1.020	1.040	1.075
2019	0.912	1.111	0.958	0.952	1.013
2020	1.108	1.052	1.040	1.065	1.165
2021	1.049	0.925	1.054	0.996	0.970
Mean	1.023	1.047	1.013	1.010	1.071

Legend:
Effch (Efficiency Change)
Tech (Technical Efficiency Change)
PEch (Pure Efficiency Change)
SEch (Scale Efficiency Change
TFPch (Total Factor Productivity Change)

Conversely, the year 2021 recorded a decline in TFP with a value of 0.970, driven by a technical efficiency reduction (0.925). This result may reflect the challenges of adjusting to post-pandemic economic conditions, where innovation and technological adoption slowed compared to the peak periods of 2020. Despite this decline, the banks maintained slight improvements in pure efficiency (1.054), demonstrating their ability to refine specific operational processes despite external pressures.

Table 4 illustrates the productivity changes of the selected universal banks in the Philippines from 2017 to 2021. The table reveals significant variability in Total Factor Productivity (TFP) growth and its components across banks, highlighting the differing efficiency dynamics within the sector. On average, the banks achieved a 7.1% TFP growth over the study period, underpinned by improvements in efficiency change (2.3%), technical efficiency change (4.7%), pure efficiency change (1.3%), and scale efficiency change (1.0%). While most banks experienced positive TFP growth, the variability in performance underscores the differing strategies and operational practices among the banks. For instance, Banks 2, 6, and 8 demonstrated modest improvements in TFP, primarily driven by technical efficiency advancements, but their lack of substantial growth in other efficiency dimensions indicates room for improvement in scaling operations and enhancing managerial effectiveness.

In addition, the mean values of each productivity component provide a benchmark for evaluating individual bank performance. On average, the highest improvement was observed in technical efficiency (4.7%), reflecting the banking sector's overall focus on technological advancements during the study period. Scale efficiency exhibited the least growth (1.0%), indicating that many banks faced challenges in optimizing their operational scale. Bank 12 demonstrated the highest TFP growth rate of 13.4%, driven by notable improvements in scale efficiency (4.5%) and technical efficiency (8.6%). This suggests that Bank 12 effectively optimized its operational scale and adopted advanced technologies, contributing to its exceptional productivity performance. Similarly, Bank 11 achieved the highest efficiency change (7.0%) and pure efficiency growth (6.5%), indicating superior managerial effectiveness and process optimization during the study period. Bank 7 recorded the highest technical efficiency growth at 8.9%, signifying its ability to leverage technological advancements to enhance its operational processes.

Table 4. *Universal banks' productivity change*

Bank	Effch	Tech	PEch	SEch	TFPch
1	0.992	1.019	0.998	0.993	1.010
2	1.000	1.062	1.000	1.000	1.062
3	1.042	1.057	1.042	1.000	1.101
4	1.063	1.026	1.057	1.005	1.090
5	0.996	1.046	1.000	0.996	1.042
6	1.000	1.002	1.000	1.000	1.002
7	1.003	1.089	1.000	1.003	1.092
8	1.009	1.092	1.000	1.009	1.002
9	1.023	1.037	1.000	1.023	1.061
10	1.041	1.016	1.000	1.041	1.058
11	1.070	1.032	1.065	1.004	1.104
12	1.045	1.086	1.000	1.045	1.134
Mean	1.023	1.047	1.013	1.010	1.071

Legend:
Effch (Efficiency Change)
Tech (Technical Efficiency Change)
PEch (Pure Efficiency Change)
SEch (Scale Efficiency Change
TFPch (Total Factor Productivity Change)

In contrast, certain banks exhibited declining performance in specific dimensions of productivity. Banks 1 and 5 recorded a 1% deterioration in efficiency change and scale efficiency, suggesting challenges in maintaining operational consistency and scale optimization. Moreover, Bank 1 experienced a 1% decline in pure efficiency, highlighting potential issues in managerial decision-making and resource allocation.

3.2. Tobit Regression Results

Table 5 displays the results of the Tobit regression model, analyzing the factors influencing the technical efficiency of selected universal banks in the Philippines. The Tobit model's constant, with a highly significant coefficient of 1.678 ($p < 0.01$), indicates a strong baseline level of technical efficiency across the sampled banks, independent of the explanatory variables. This suggests that factors outside the model, such as management practices or institutional characteristics, might play a significant role in influencing efficiency.

Table 5. *Factors affecting bank technical efficiency*

Independent Variables	Coefficients	SE	Z	P> |z|
LQ	-0.999	.5455818	-1.83	0.067*
CAR	-0.002	.0159039	-0.11	0.910
RGDPGR	0.0002	.0033384	0.06	0.952
IR	0.0197	.0144902	1.36	0.175
(Constant)	1.678	.4190366	4.00	0.000
Mean	1.023	1.047	1.013	1.010

*Significant at 10% level

Loan quality (LQ) demonstrates a significant negative impact on bank technical efficiency, with a coefficient of -0.999. This finding suggests that an increase in the LQ ratio—typically indicating a higher proportion of non-performing loans or default risk—adversely affects a bank's operational efficiency. The higher the risk associated with loan portfolios, the more resources banks must allocate to manage these risks, which can lead to inefficiencies in resource utilization and operational processes (Lysiak et al., 2022). This result underscores the critical importance of effective credit risk management strategies in maintaining and enhancing bank efficiency.

Although insignificant, the inflation rate (IR) exhibits a positive relationship with technical efficiency, as indicated by a coefficient of 0.0197. This result suggests that, in the context of rising inflation, banks may experience an increase in net interest income and stock value (Piazzesi & Schneider, 2009), enhancing their attractiveness to investors. These factors could indirectly contribute to operational efficiency by providing banks with additional financial resources to optimize their processes and expand their services. However, the insignificance of this variable indicates that the relationship is not strong enough to be conclusive.

Similarly, the real GDP growth rate (RGDPGR) has a positive but insignificant effect on technical efficiency, with a coefficient of 0.0002. Higher economic growth is generally associated with increased consumer purchasing power and demand for banking services (e.g., Blanchet & Lenseigne, 2019; Inganga et al., 2014), which can lead to improved efficiency in bank operations. However, the insignificance of this relationship suggests that GDP growth alone may not be a primary determinant of technical efficiency in the Philippine banking sector.

The Capital Adequacy Ratio (CAR) shows a negative but insignificant relationship with technical efficiency, with a coefficient of -0.002. While a higher CAR implies greater financial stability and the ability to absorb losses, it may also reflect a conservative approach to capital management (Lu, 2024; Pacces & Heremans, 2012), potentially limiting investments in efficiency-enhancing technologies or innovations. This finding suggests that while CAR is crucial for financial soundness, its direct impact on efficiency might be limited in this context.

4. CONCLUSION

This study highlights the critical importance of addressing efficiency issues in the banking sector, particularly among universal banks in the Philippines. Under the VRS condition, three banks (Banks 3, 4, and 11) were identified as inefficient during the 2016–2021 period, attributed primarily to underutilized inputs such as labor and physical capital. Productivity analysis revealed a 7.1% total factor productivity (TFP) growth rate from 2017 to 2021, with the highest annual growth (16.5%) occurring in 2020, driven by significant contributions from technical efficiency improvements (4.7%). However, some banks, such as Banks 1 and 5, showed a 1% deterioration in efficiency and scale efficiency during the same period. The Tobit regression analysis found loan quality to be the only statistically significant factor influencing technical efficiency, with a negative effect. Other factors—such as inflation rate, real GDP growth rate, and capital adequacy ratio—showed positive but statistically insignificant relationships with technical efficiency.

To address these inefficiencies, the study recommends that underperforming banks adopt the best practices of their efficient peers, as identified through the DEA results. Additionally, banks with declining Malmquist Index values should focus on the specific sources of inefficiency—whether operational or scale-related—and take corrective measures to enhance productivity and sustainability. Policymakers and banking professionals can use these findings to refine strategies aimed at optimizing resource utilization and improving the overall stability of the banking sector.

The study has several limitations, primarily its focus on only 12 of the 24 universal banks in the Philippines due to data availability. The analysis is also restricted to the 2016–2021 period, which may limit the generalizability of the findings. Future research should expand the scope to include all universal banks and a longer time frame to capture broader trends and enhance the robustness of the results. Incorporating additional variables, such as digital transformation initiatives, customer satisfaction metrics, and external economic shocks, could provide deeper insights into the determinants of bank efficiency. Employing alternative statistical methods, such as stochastic frontier analysis or other multivariate techniques, may also offer a comparative perspective and strengthen the methodological framework. These recommendations aim to support further advancements in understanding and improving bank efficiency in the Philippine context.

5. LIMITATIONS OF THE STUDY

The study acknowledges potential biases inherent in the DEA and Tobit Regression methodologies. One limitation of DEA is its sensitivity to outliers and extreme values, which can distort efficiency scores. To address this, data were pre-processed, and outliers were identified and excluded using standardized thresholds. Additionally, the study mitigated bias arising from sample selection by including all universal banks in the Philippines with available data from 2016 to 2021. The use of secondary data introduces potential issues related to data accuracy and consistency. To minimize this, data were sourced from reputable and consistent repositories, including World Bank databases and annual reports from the respective banks.

Finally, the study acknowledges that DEA does not account for external macroeconomic influences directly. The inclusion of inflation rate, real GDP growth rate, and capital adequacy ratio as regressors in the Tobit model addresses this limitation, ensuring a comprehensive analysis of both operational and contextual factors affecting technical efficiency. This methodological rigor strengthens the study's contribution to understanding bank efficiency in the Philippine context.

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