ISSN No: 2704-4327 (online)
ISSN No: 2651-768X (print)

TECHNICAL EFFICIENCY OF A RURAL BANK'S BRANCHES IN DAVAO REGION: A DATA ENVELOPMENT APPROACH

Jeriel Igloria[1,2], Enrico Yee Jr.[2]

[1]BDO Rural Bank (formerly One Network Bank), Davao City.
[2]College of Business Administration, University of Southeastern Philippines, Davao City

ABSTRACT

This study evaluates the technical efficiency of rural bank branches using Data Envelopment Analysis (DEA) to identify operational inefficiencies and recommend improvement strategies. Utilizing data from 21 branches over three consecutive years, the study benchmarks efficiency levels through the BCC model, focusing on personnel, floor space, and technology usage. Results revealed consistent inefficiencies in several branches, which could be addressed through targeted resource augmentation and process optimization. Efficient branches, such as Calinan and Mintal, emerged as benchmarks, offering actionable insights for enhancing overall branch performance. Recommendations include strategic investments in infrastructure, personnel training, and the replication of best practices to improve service delivery and align with stakeholder expectations. This study provides a framework for operational improvements that contribute to long-term sustainability and customer satisfaction in rural banking.

Keywords: technical efficiency, rural banks, data envelopment analysis, benchmarking, operational optimization

INTRODUCTION

The banking industry plays a critical role in the stability and growth of economies worldwide, serving as the backbone of financial intermediation. Banks are not only crucial for facilitating economic transactions but also for providing credit and investment channels necessary for development. Over the years, the industry has seen remarkable transformations due to globalization, technological advancements, and regulatory reforms. Particularly in developing countries, banking markets have become increasingly interconnected, driven by financial liberalization policies (e.g., Apaydin & Çoban, 2023; Botta, 2021). The Philippines, for instance, liberalized its banking sector with the enactment of Republic Act (RA) 10641 in 2014, which allowed the full entry of foreign banks. This milestone aimed to integrate the country into the ASEAN Economic Community and strengthen its financial sector (Chen, 2018). However, this liberalization also introduced unprecedented challenges, such as heightened competition and systemic vulnerabilities (Morrow, 2015), that demand empirical investigation.

Despite significant advances in banking operations and the advent of innovative technologies, inefficiencies persist across the global banking industry. Research indicates that inefficiencies are a precursor to failures, with inefficient banks at greater risk of being driven out of the market (Misra & Coccorese, 2022; Morelli, 2023; Murcia et al., 2018). In the Philippines, small and medium-sized rural banks face unique challenges, including resource constraints, regulatory compliance burdens, and the competitive pressures introduced by foreign entrants (Marquis, 2018; Meyer, 2000; Sandoval & Milo, 2018). These systemic inefficiencies are not just isolated problems but rather reflect a larger issue affecting decision-making processes and operational strategies in banks. Such inefficiencies remain poorly understood in terms of their root causes and the degree to which they affect operational sustainability, especially in the context of rural banks.

Traditional methods of assessing banking performance, such as profitability metrics (e.g., return on assets, return on equity) and operational ratios (e.g., output per staff member), have long been used as proxies for efficiency. However, these measures fail to account for the multidimensional nature of bank operations, ignoring critical inputs that significantly influence outputs and costs (Azad, 2018; Gogovie, 2019; Omete, 2023). To address this, frontier efficiency analyses, particularly Data Envelopment Analysis (DEA), have gained traction as a robust alternative. DEA enables banks to benchmark their efficiency against best practices without requiring prior assumptions about the production frontier (Bhatia et al., 2021; Goyal et al., 2019; Rostamzadeh et al., 2021). While its applications in the financial services sector have grown considerably, studies focused on rural banks remain sparse. This highlights a significant research gap, as rural banks are key players in financial inclusion, particularly in underserved areas.

Operational problems in banks are not isolated to one region or country; they are a systemic issue that perplexes industry experts. Factors such as inefficient resource allocation, ineffective management practices, and limited technological adoption continue to hinder the operational efficiency of banks globally (Handoyo et al., 2023; Krisciukaityte, Balezentis & Streimikiene, 2023; Shah, Wu & Korotkov, 2019). The question of how rural banks in Davao Region cope with these challenges—given their resource limitations and exposure to competitive pressures—is particularly pressing. A deeper understanding of these operational inefficiencies can provide actionable insights for bank management, regulators, and policymakers to address these problems empirically and systemically.

This study aims to investigate the technical efficiency of rural banks' branches in Davao Region using DEA as the primary analytical tool. Specifically, it seeks to identify the input and output factors contributing to inefficiencies, and at what specific optimum levels are there for bank branches to become efficient. By focusing on a specific rural bank's branches in Davao Region, the study not only addresses a critical gap in the literature but also contributes to the broader discourse on operational sustainability in rural banking sector. The findings will provide practical recommendations for improving operational efficiency, ensuring the resilience of rural banks amidst growing competition, and enhancing their role in promoting financial inclusion.

Ultimately, this research endeavors to contribute to the growing body of knowledge in decision sciences by offering empirical evidence on systemic inefficiencies in the banking sector. The study is structured to provide a comprehensive review of existing methodologies, present an empirical analysis of rural banks' technical efficiency, and offer practical solutions. By situating the discussion within the context of systemic operational challenges, this research aims to bridge the gap between theory and practice, benefiting both the academic community and the banking industry.

Statement of the Problem

This study focuses on determining which branches of a rural bank in Davao Region are the best frontiers for three (3) operational years and to determine the overall efficiency estimates of the rural bank. Specifically, this study is directed to answer the following questions:

1. What is the distribution of the factor inputs of rural bank branches in Davao Region in terms of number of personnel, number of computers/PCs in workstations, and floor space (in sqm)?

2. What is the distribution of the factor outputs of rural bank branches in Davao Region in terms of number of ATM transactions, number of released ATM cards, number of loan accounts, and number of savings accounts opened?

3. How efficient are the rural bank's branches across time?

4. What are the necessary input and output improvements for each rural bank branch for them to be fully efficient?

Significance of the Study

The findings of this study will be particularly significant to various stakeholders in the context of the banking industry in the Davao Region. By focusing on the technical efficiency of rural bank branches, the research can contribute to evidence-based decision-making processes that directly benefit key stakeholders.

Branch Banking Group. The study will provide the Branch Banking Group with vital insights to identify branches operating at the best-practice frontier and those that are underperforming. This information can be used to pinpoint the specific operational gaps in less productive branches and recommend targeted improvements to elevate their efficiency levels. By addressing inefficiencies, the Branch Banking Group can improve overall branch profitability, reduce operating costs, and optimize resource utilization, ultimately leading to better performance across the region.

Rural Bank's Human Resource Department. The research will equip the Human Resource Department with the necessary data to design and implement an evidence-based incentive program that rewards high-performing branches and employees. By focusing on high-value activities that contribute to profitability and operational efficiency, the department can ensure that the incentive system motivates employees effectively and aligns with the bank's overall strategic goals. Such initiatives can improve employee engagement and productivity in the Davao Region's rural banking sector.

Rural Bank's Branch Managers. For branch managers, the study will provide actionable insights into how time, resources, and managerial efforts are allocated relative to profitability targets. The analysis will enable managers to understand their branch's relative efficiency or inefficiency compared to others. This information can also facilitate the transfer of best practices and managerial expertise from well-performing branches to those that require support. Ultimately, branch managers can utilize these insights to make more informed decisions, optimize resource allocation, and achieve organizational goals.

Regulators and Policymakers. The study can serve as a valuable resource for regulators and policymakers in the Davao Region. By identifying systemic inefficiencies and offering data-driven recommendations, the findings can guide the creation of policies and frameworks that foster a more efficient banking system. This can also contribute to enhancing financial inclusion efforts, particularly in underserved areas.

Local Communities and Customers. Indirectly, the study benefits local communities and customers who rely on rural banks for their financial needs. More efficient banking operations can translate into improved services, lower costs, and enhanced access to credit, which are crucial for supporting the economic development of the Davao Region.

Theoretical Framework

The study is grounded in the concept of technical efficiency, which evaluates how effectively banks utilize their resources to achieve desired outputs. Technical efficiency can be assessed through two approaches: input-oriented and output-oriented. As Coelli et al. (2005) explained, the input-oriented approach measures how much input quantities can be proportionally reduced without affecting output levels, while the output-oriented approach determines the extent to which output quantities can be increased without changing input levels. In the context of rural bank branches in the Davao Region, this study adopts the input-oriented approach, given that branch managers are presumed to have greater control over operational inputs, such as personnel and expenses, rather than external outputs like loans and revenue (Yang, 2009). This approach aligns with the operational focus of branch-level management.

The study also explores the **determinants of efficiency**, which include both bank-specific and environmental factors. Literature highlights key internal variables such as size, profitability, capitalization, and loans-to-assets ratios (Casu & Molyneux, 2003; Casu & Girardone, 2004), along with managerial characteristics like the educational profile of staff and executive affiliations (Isik & Hassan, 2003). Additionally, external factors like regional economic growth and market conditions also influence branch efficiency. This framework is particularly relevant in the Davao Region, where diverse market conditions and varying branch capabilities necessitate an empirical analysis to identify operational strengths and inefficiencies, aiding decision-makers in optimizing performance.

Finally, this study incorporates the **production approach** in evaluating efficiency, which is suitable for branch-level analysis as it measures outputs, such as transaction volumes and account services, and inputs like labor and capital (Berger & Humphrey, 1997). The production approach contrasts with the intermediation approach, which is more appropriate for analyzing financial institutions as a whole. Additionally, the study acknowledges the role of environmental factors outside managerial control, such as regional economic conditions (Paradi & Schaffnit, 2004). This comprehensive framework provides a structured lens to examine operational inefficiencies and develop strategies to enhance the performance of rural bank branches in the Davao Region, contributing to a deeper understanding of systemic issues in the banking sector.

METHOD

Research Design

This research used a quantitative, descriptive-exploratory approach to evaluate the technical efficiency of rural bank branches in the Davao Region throughout three operating years. The research used the data envelopment analysis (DEA) method, a non-parametric technique recognized as a useful instrument for assessing efficiency in banking processes (Asmare & Begashaw, 2018; Balcerzak et al., 2017). Data envelopment analysis (DEA) is suitable for this research since it facilitates the comparison of various decision-making units (DMUs), such as bank branches, by using numerous inputs (e.g., staff, computers, floor space) and outputs (e.g., ATM transactions, loan accounts). The

ISSN No: 2704-4327 (online)
ISSN No: 2651-768X (print)

method's adaptability in managing various aspects corresponds with the study's aim of establishing efficiency frontiers and pinpointing input-output discrepancies (Liu, Lu & Lu, 2016). This approach guarantees a rigorous and impartial evaluation of branch performance, tailored to the local banking context in the Davao Region.

This research method is particularly suitable due to its emphasis on operational efficiency at the branch level, directly addressing the study's primary inquiries on input-output distributions and temporal efficiency. Through the integration of DEA, the research identifies the most efficient branches and offers actionable recommendations for underperforming branches to achieve maximum efficiency. This investigative method is crucial for rural banks in the Davao Region, since operational discrepancies across branches are likely affected by differing local economic situations, client demographics, and resource accessibility. This data-driven architecture aids in evidence-based decision-making, hence improving branch productivity and competitiveness in the regional banking sector.

Data

The dataset for this study consists of input and output variables collected from rural bank branches operating in the Davao Region over three consecutive calendar years (CYs). These data points reflect operational factors critical to determining technical efficiency through data envelopment analysis (DEA). The analysis will consider inputs as the resources utilized by the branches and outputs as the services or products generated.

Input Variables	Output Variables
• **Number of Personnel** – Refers to the total number of employees allocated to each branch for daily operations, representing labor as a key input. • **Number of Computers/PCs in Workstations** – Captures the availability of technological infrastructure to facilitate banking services. • **Floor Space (in square meters)** – Indicates the physical area of each branch, which influences customer handling capacity and operational logistics.	• **Number of ATM Transactions** – Reflects the level of customer usage of automated teller machines, indicating service accessibility. • **Number of Released ATM Cards** – Measures the extent of new customer acquisition or existing customer service improvements. • **Number of Loan Accounts** – Represents the branch's credit activity, a significant factor in revenue generation. • **Number of Savings Accounts Opened** – Captures the branch's ability to attract depositors, contributing to financial intermediation.

In this study, an input-oriented DEA model was utilized to evaluate the efficiency of a rural bank's branches. The DEA equation is expressed as follows:

$$\text{Efficiency} = \max_{\lambda} \frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}}$$

Where:

- y_{rj}: Output r for branch j ($r = 1, 2, ..., s; j = 1, 2, ..., n$).
- x_{ij}: Input i for branch j ($i = 1, 2, ..., m$).
- u_r: Weight assigned to output r.
- v_i: Weight assigned to input i.
- λ: Variable used to scale the outputs relative to inputs.

For this study:

- Inputs: x_1 (Personnel), x_2 (Computers), x_3 (Floor Space).
- Outputs: y_1 (ATM Transactions), y_2 (ATM Cards Released), y_3 (Loan Accounts), y_4 (Savings Accounts Opened).

This equation will be applied to compare the relative efficiency of branches by calculating the ratio of weighted outputs to weighted inputs. Branches operating on the efficiency frontier will have a score of 1 (100% efficient), while others will have efficiency scores below 1, highlighting areas requiring improvement in resource allocation or output generation.

Procedures

Data collection procedure for this study followed a structured approach to ensure the integrity and reliability of the information gathered. First, formal permission was sought from the management of the rural bank to conduct the study. This involved submitting a request letter to 's president, detailing the purpose, objectives, and significance of the research, emphasizing how the findings could contribute to the bank's operational efficiency and strategic decision-making.

Once permission was granted, the researchers formally requested access to the specific data required for the study. This included information on input factors (number of personnel, number of computers/PCs in workstations, and floor space) and output factors (number of ATM transactions, number of released ATM cards, number of loan accounts, and number of savings accounts opened) for all branches within the Davao Region, covering a span of three operational years. To ensure compliance with ethical standards and data privacy regulations, the researchers committed to using the information solely for academic purposes and maintaining its confidentiality. The researchers also heeded the request of the bank to not identify the CYs to maintain anonymity of bank performances for specific years.

Data Analysis

The study employed data envelopment analysis (DEA) as the primary statistical tool to evaluate the operational efficiency of rural bank branches in the Davao Region across three consecutive years. DEA is a non-parametric approach that measures the relative efficiency of decision-making units (DMUs), in this case, the bank branches, by comparing their inputs and outputs. This method was selected for its robustness in identifying best-practice frontiers and pinpointing inefficient branches needing improvement.

The DEA analysis was conducted using DEAP 2.1 software, developed by Coelli (1996), which facilitates efficiency estimations under both input- and output-oriented frameworks. The input-oriented model was used, given that bank managers have greater control over resource allocation (e.g., personnel, computers, floor space) than the outputs (e.g., ATM transactions, loan accounts). The software provided efficiency scores for each branch, indicating how close they were to the efficiency frontier.

RESULTS AND DISCUSSION

Descriptive Statistics of Factor Inputs and Outputs of the Rural Bank's Branches

The ensuing discussions focused on discussing the results of the process of determining the descriptive statistics of the decision-making units (DMUs), which are the branches of the rural bank currently studied. There are three input factors and four output factors in this study that were used in the estimation process. Factor inputs include: (i) number of personnel, (ii) number of computers/PCs in workstations, and (iii) floor space (in sqm). On the other hand, factor outputs include: (i) number of ATM transactions, (ii) number of released ATM cards, (iii) number of loan accounts, and (iv) number of savings accounts.

In was explicit in Figure 1 that in terms of number of personnel servicing the bank, San Pedro Branch employs the greatest number of personnel. It has employed 22 personnel for Year 1 and hired additional personnel for Year 2. It maintained its number of personnel in the next year. San Pedro Branch is followed by Calinan Branch, which employed 16 employees for Year 1 and 18 employees for Years 2 and 3, and Quirino Branch, which employed 16 employees for Year 1 and added one personnel in every year that passed. On the other hand, the branches which have the least personnel are Padada Branch and Sta. Maria Branch, which employed five personnel in Year 1, 6 personnel in Year 2 and 7 personnel in Year 3. On the average, the branches of One Network Bank employed an average of 11 personnel for Year 1, and 12 personnel for Year 2 and 3.

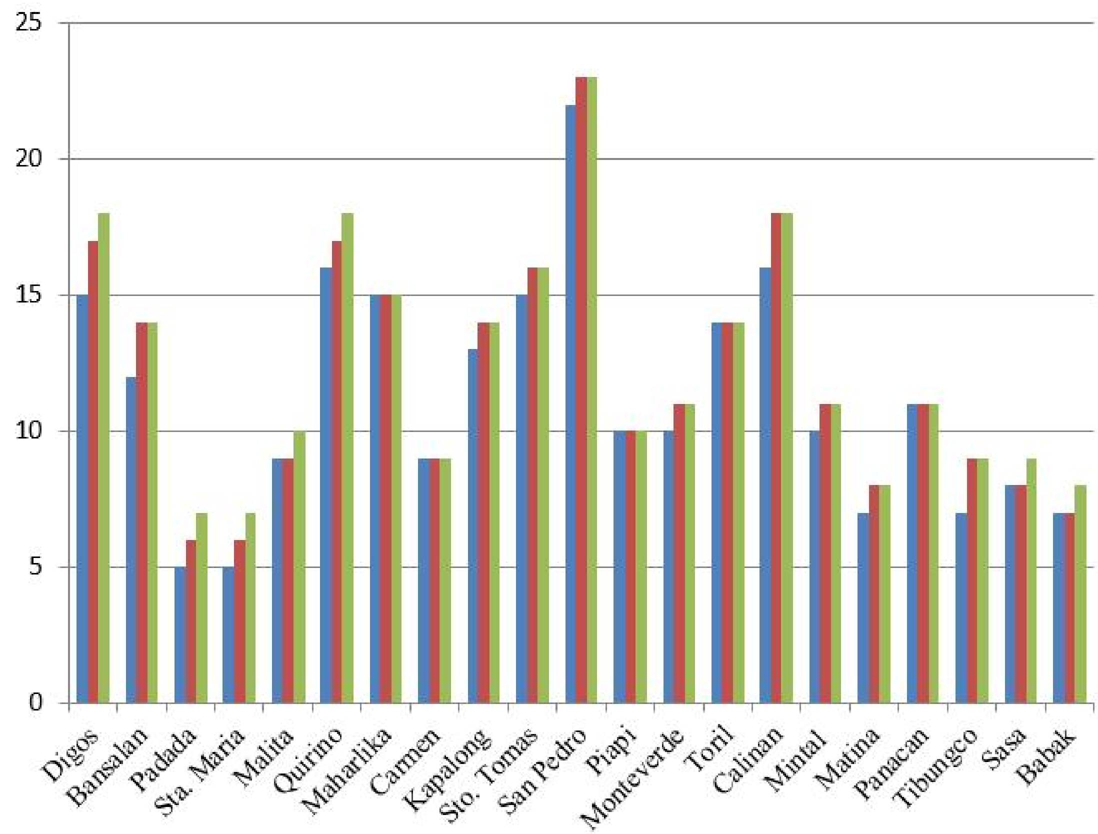

Figure 1. Descriptive statistics showing the profile of the rural bank's branches in terms of number of personnel

Figure 2 shows that in terms of number of PCs/workstations, the San Pedro tops the list, having 21 PCs/workstations. Note that the same branch employs the highest number of personnel in the previous analysis; safe to say, the higher number of personnel means the higher PCs or workstations will be. This was followed by Quirino Branch which has 18 workstations in the span of three years, and branches in Digos and Calinan, both of which have 17 workstations in the span of three years. On the other hand, Matina Branch has the least number of PCs or workstations, which is consistently eight PCs in the span of three years. On the average, the rural bank branches made use of 13 PCs/workstations for its operations for three years.

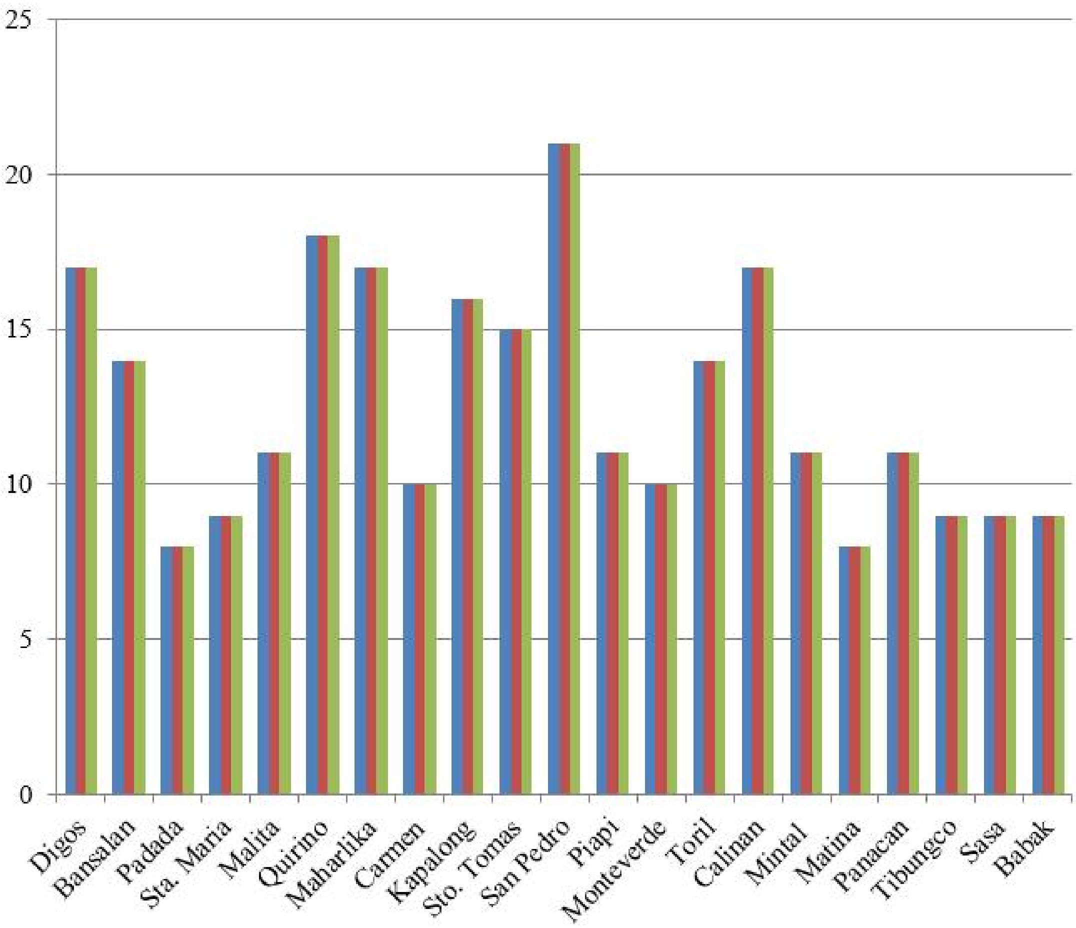

Figure 2. Descriptive statistics showing the profile of the rural bank branches in terms of number of PCs

Lastly for the factor inputs, Figure 3 revealed that in terms of floor space, San Pedro Branch is the biggest in terms of occupancy (620 sqm). It was followed by Quirino Branch (548 sqm), Calinan Branch (348 sqm), and Monteverde Branch (342 sqm). On the other hand, Carmen Branch occupies the least floor space among the branches (59 sqm). On the average, the rural bank branches occupy 293 sqm.

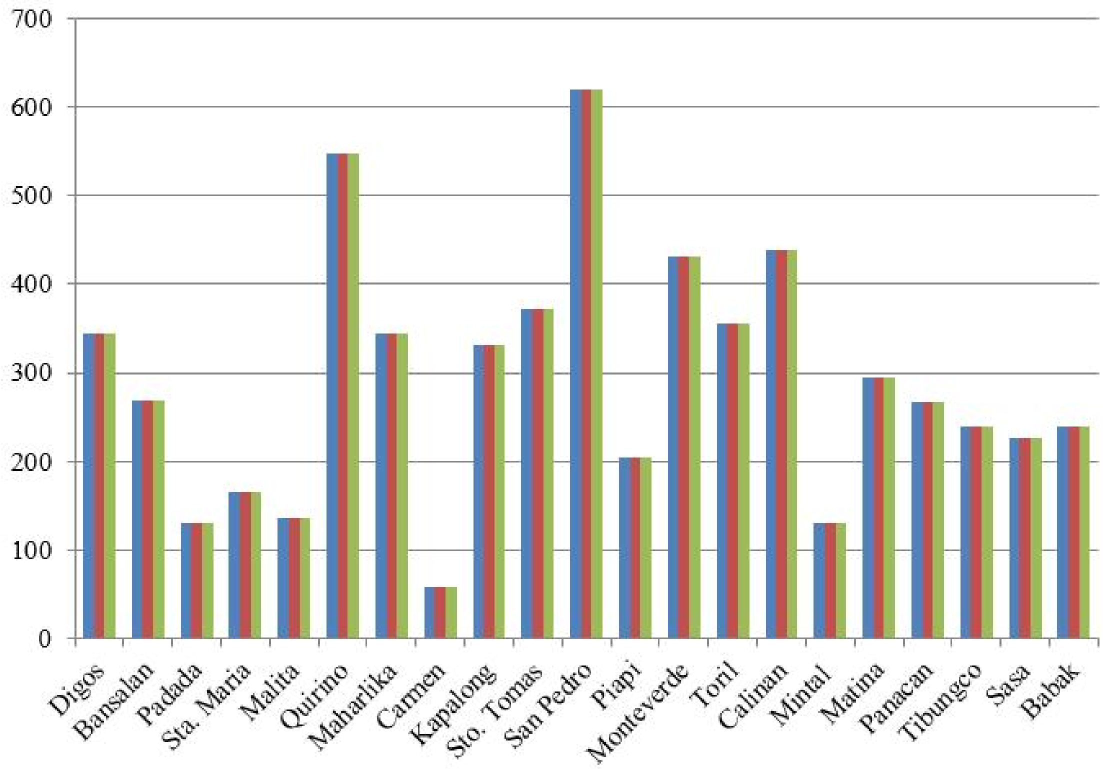

Figure 3. Descriptive statistics showing the profile of the rural bank's branches in terms of floor space

For the factor outputs, Figure 4 shows that in terms of number of ATM transactions per branch, Calinan Branch topped all the DMUs considered in the analysis, having a total 340,485 transactions in Year 1, rising to 354,158 transactions in Year 2. It, however, dropped to 338,891 in Year 3, yet remained the highest among branches to have catered these much ATM transactions. Coming second is Sto. Tomas Branch with 234,710 transactions in Year 1, 253,789 transactions in Year 2, and 258,543 in Year 3, while Mintal Branch was found to be the third branch with highest number of ATM transactions, having 228,060 transactions for Year 1, 250,398 transactions for Year 2, and 233,029 transactions for Year 3.

On the other hand, Carmen Branch has the least ATM transactions for Years 1 and 2 with only 29,060 and 50,385 transactions, respectively, and Matina Branch for Year 3, with only 2,484 transactions. No ATM transactions were recorded for the branches in Sta. Maria, Piapi, Monteverde and Matina for Years 1 and 2, and Piapi Branch remained to have no ATM transaction in Year 3. This may be due to the fact that these branches are new branches, or the ATM servicing facility might not be available for the period. On the average, the branches have served 95,052 ATM transactions in Year 1, 102,457 transactions in Year 2, and 100,442 transactions in Year 3.

International Journal of Multidisciplinary Studies | Vol 5, No. 1, Dec 2023
ISSN No: 2704-4327 (online)
ISSN No: 2651-768X (print)

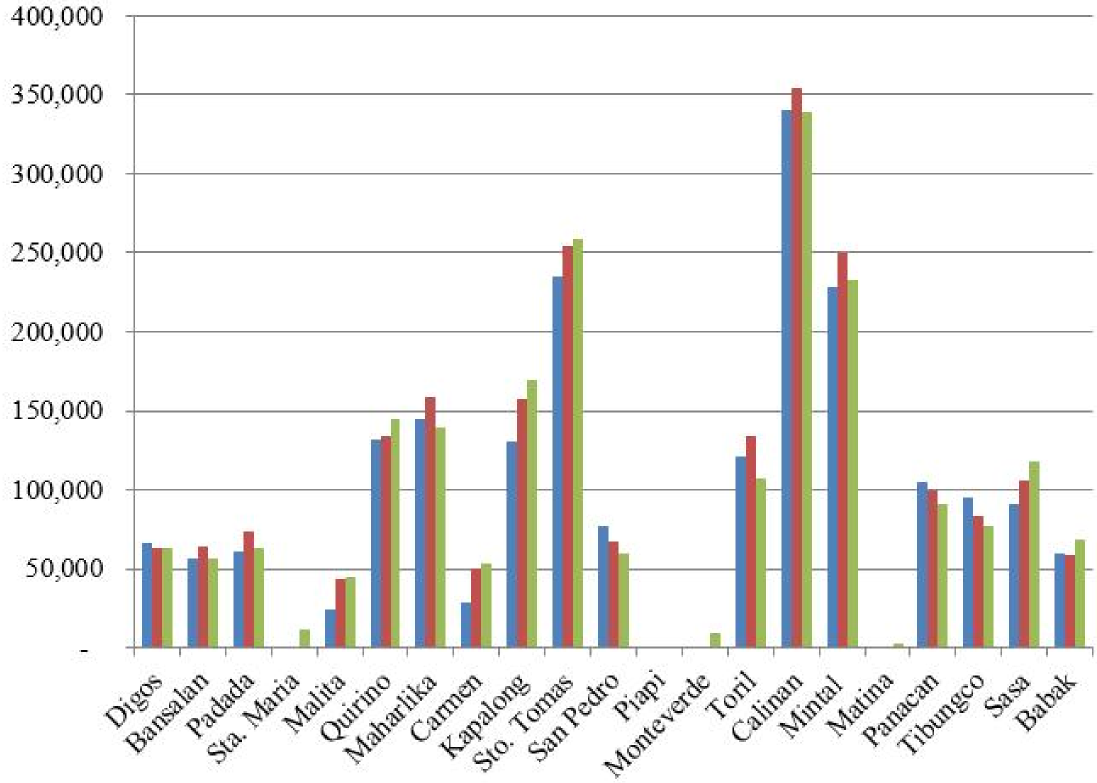

Figure 4. Descriptive statistics showing the profile of the rural bank's branches in terms of number of ATM transactions

In addition, Figure 5 shows that in terms of number of ATM cards released per branch, San Pedro Branch topped all the DMUs considered in the analysis, having released a total of 26,510 ATM cards in Year 1, increasing to 30,082 cards in Year 2, and 32,332 cards in Year 3. Coming second and just close with San Pedro Branch is Calinan Branch, with 26,258 transactions in Year 1, then rose to the top in Year 2 with 30,462 transactions, and maintained the spot in Year 3 with 34,534 cards issued, while Quirino Branch was found to be the third branch with highest number of ATM cards issued, releasing 16,238 cards in Year 1, 19,826 transactions in Year 2, and 22,798 cards in Year 3. On the other hand, Sta. Maria has not released any ATM card in Year 1, making it the branch in the last spot for ATM card released. It remained on the same spot on the two succeeding years, with only 99 and 691 ATM cards released, respectively. On the average, the branches have served 8,356 ATM cards in Year 1, 10,445 ATM cards in Year 2, and 12,063 ATM cards in Year 3.

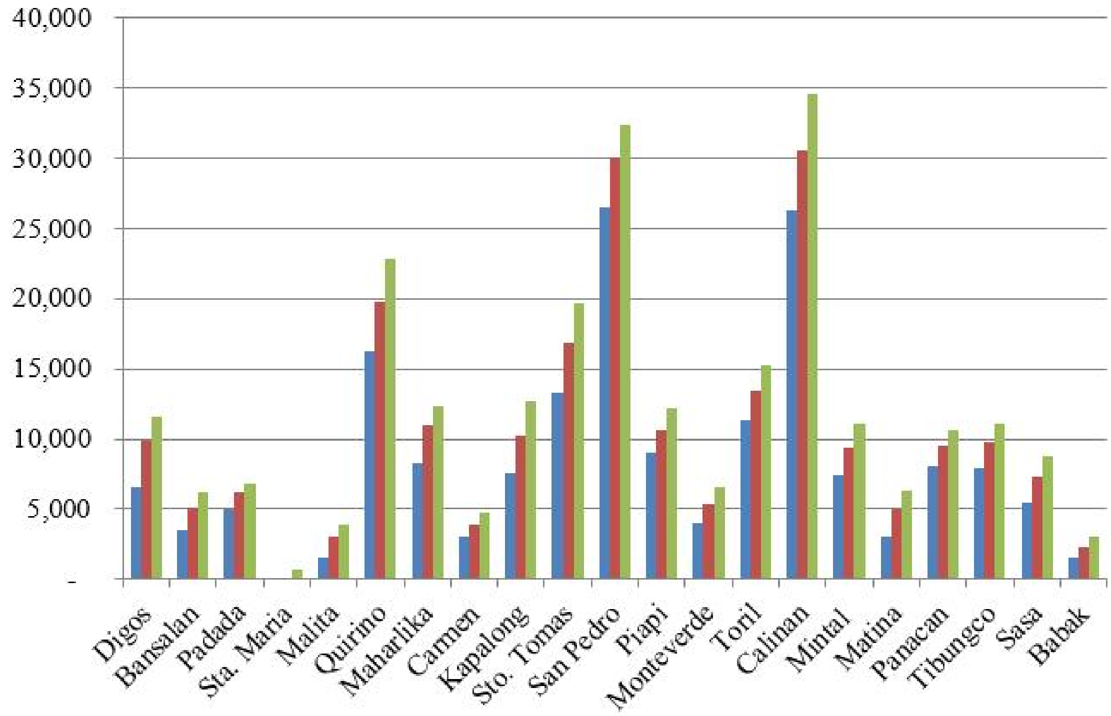

Figure 5. Descriptive statistics showing the profile of the rural bank's branches in terms of number of ATM cards released

Figure 6 shows that in terms of number of loan accounts created per branch, San Pedro was the top branch to have granted 3,177 loan accounts in Year 1, rising to 3,087 loan accounts in Year 2, and 3,287 loan accounts in Year 3. Coming second is Calinan Branch with 2,331 loan accounts granted in Year 1, 2,384 loan accounts in Year 2, and maintained the spot in Year 3 with 2,833 accounts granted. Digos was third in terms of number of loan accounts created in Year 1 (1,719 loan accounts) and Year 3 (1,766 loan accounts), since Quirino Branch managed to have increased its granted loan in Year 2, approving 1,568 loan accounts – a few accounts ahead of Digos Branch. On the average, the rural bank's branches have granted 996 loan accounts in Year 1, 984 loan accounts in Year 2, and 1,163 loan accounts in Year 3.

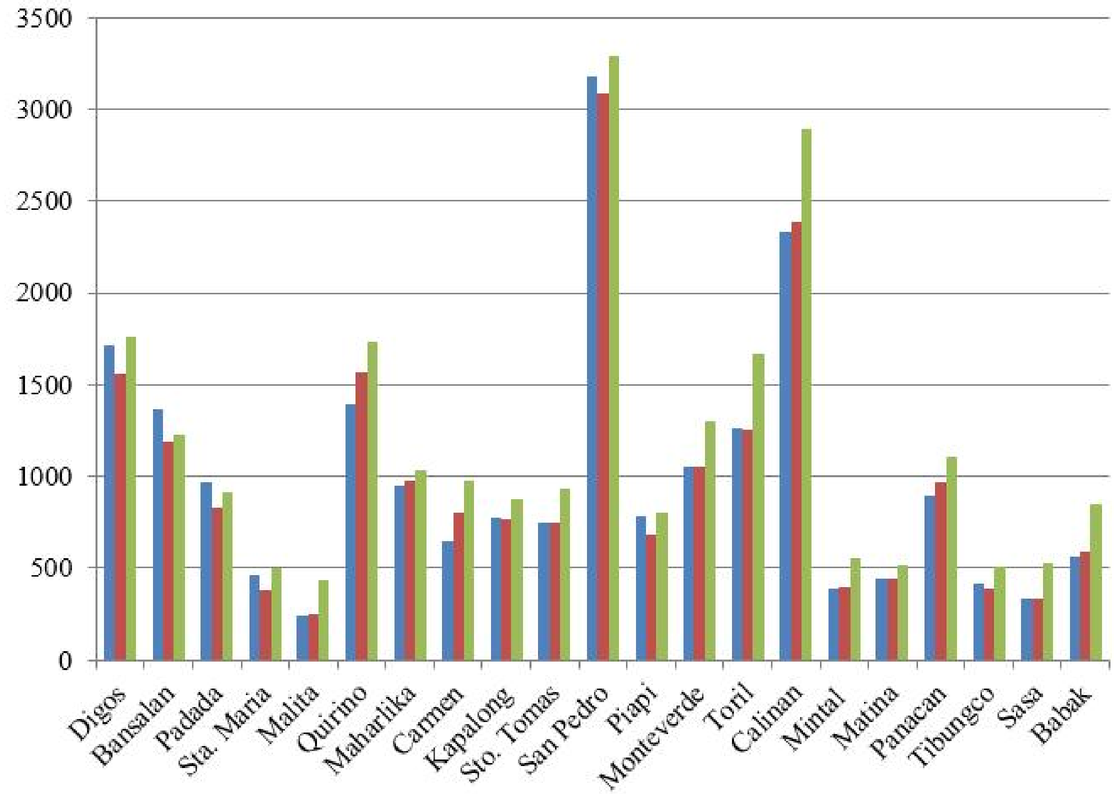

Figure 6. Descriptive statistics showing the profile of the rural bank's branches in terms of number of loan accounts

Figure 7 shows that in terms of number of savings accounts created per branch, San Pedro was the top branch to have accommodated 22,915 accounts in Year 1, decreasing to 22,248 accounts in Year 2, and catering to cater 20,899 accounts in Year 3. This branch was overtaken by Calinan Branch in Year 3, with the latter accommodating 21,804 savings account. Calinan Branch was second as it has opened 19,003 savings accounts in Year 1, increasing to 20,036 savings accounts in Year 2. Quirino Branch placed third in terms of number of savings accounts opened, as it opened 17,021 savings accounts in Year 1, 16,961 savings accounts in Year 2, and 17,681 savings accounts in Year 3. On the other hand, the branch in Sta. Maria came the last in terms of savings account generation, having only 1,739 in Year 1, 1,630 in Year 2, and 1,709 accounts served in Year 3. On the average, the rural bank's branches have served 8,596 accounts in Year 1, 8,874 accounts in Year 2, and 9,222 accounts in Year 3.

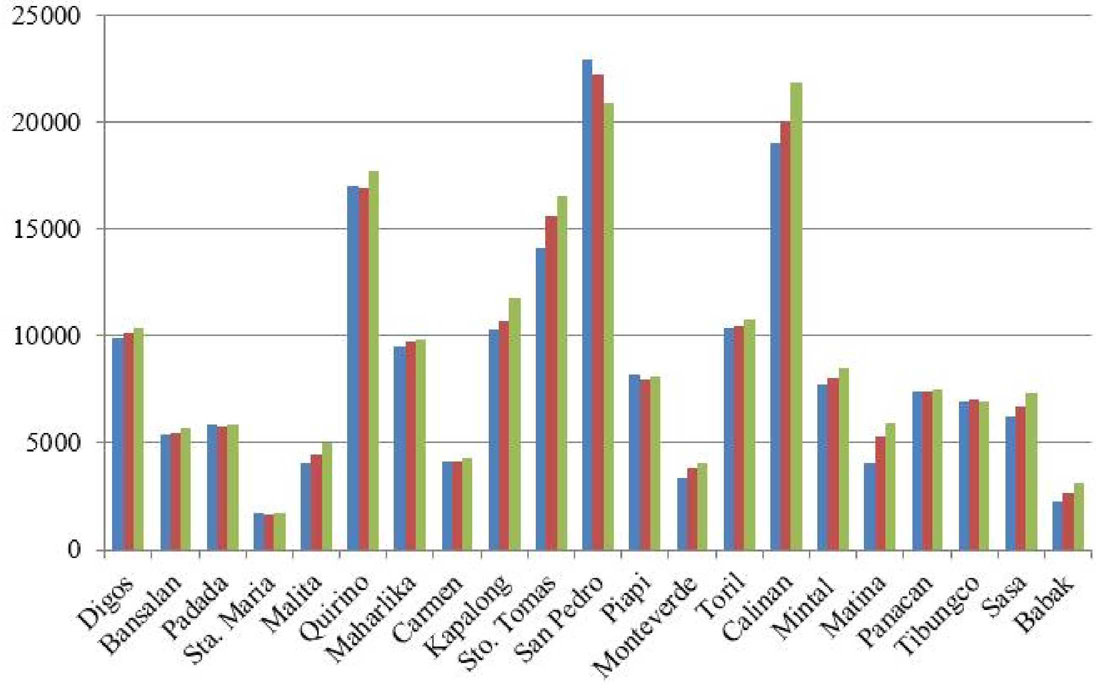

Figure 7. Descriptive statistics showing the profile of the rural bank's branches in terms of number of savings accounts opened

Technical Efficiency Analysis of a Rural Bank's Branches

To what extent may a firm's input utilization be reduced if employed effectively to get the same output level? The answer to this inquiry introduces an input-oriented metric. Input-oriented DEA employs just the fixed elements of production as variables for capacity assessment. This approach demonstrates that an inefficient unit may achieve efficiency by proportionally reducing its inputs while maintaining stable output proportions. The CCR model produces consistent efficiency irrespective of being input or output-oriented, unlike the BCC paradigm (Vaneman & Trianfis, 2001). This efficiency estimate, represented as a number between zero and one, serves as a measure of the efficiency level of a DMU. A value of one signifies that the DMU is completely technological.

Presented in Figure 8 are the technical efficiency scores of the branches of the rural bank's branches in Year 1. A multi-stage input-orientated data envelopment analysis under the constant returns-to-scale assumption was used in obtaining the technical efficiency scores using the factor inputs and outputs presented. Two DEA models were created to delineate the combination of ATM transactions per branch and ATM cards released as outputs for Model 1, and number of loan accounts and number of savings accounts created as outputs for Model 2. These specifications are in line with the principle that the outputs can either be considered as servicing (Model 1) and capital build-up (Model 2).

ISSN No: 2704-4327 (online)
ISSN No: 2651-768X (print)

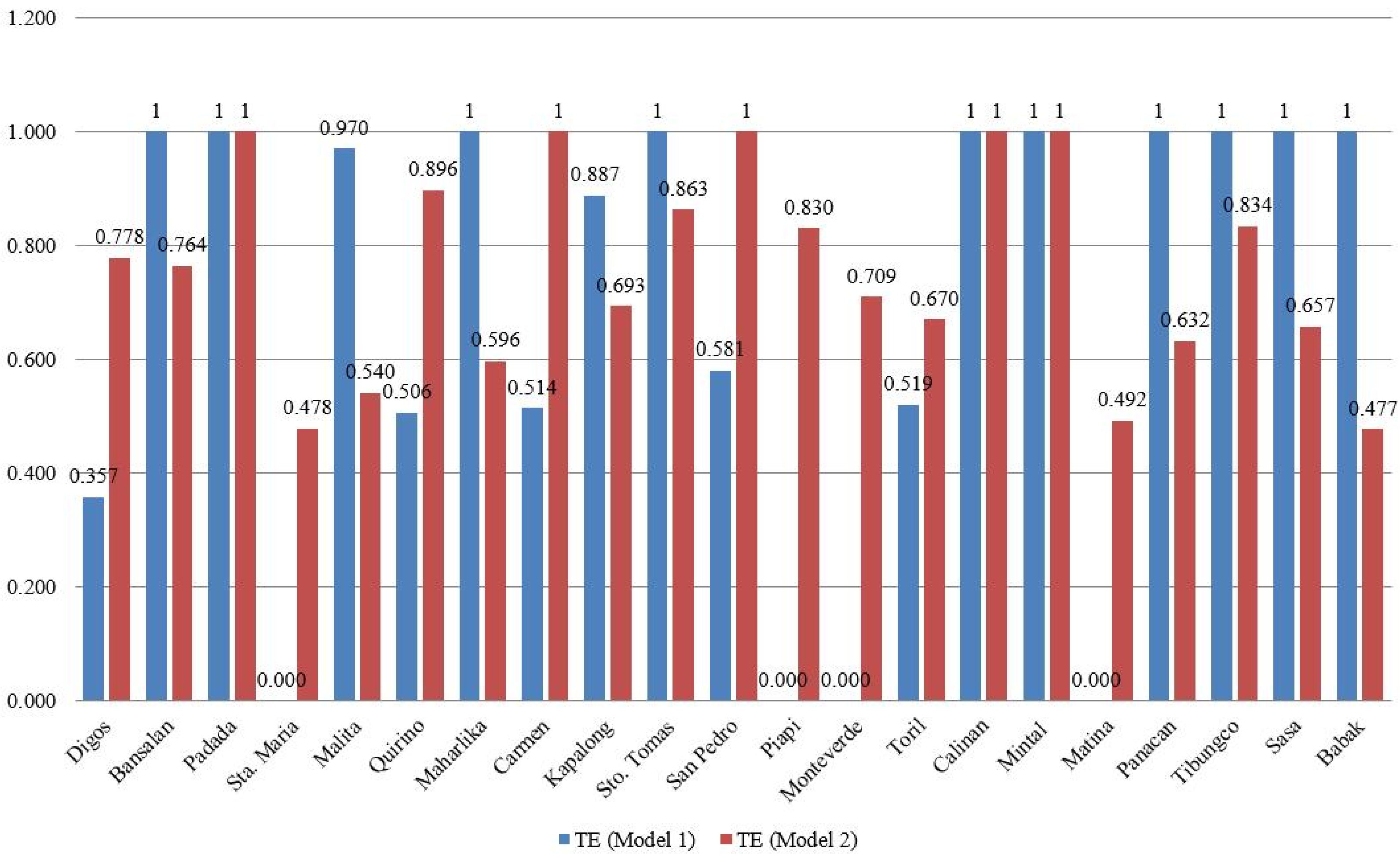

Figure 8. Technical Efficiency (CRS) Scores of the Rural Bank's Branches for Year 1

In Year 1, Model 1 revealed that 10 branches achieved complete technical efficiency scores: Bansalan, Padada, Maharlika, Sto. Tomas, Calinan, Mintal, Panacan, Tibungco, Sasa, and Babak. The 10 branches demonstrated a complete TE score of 1.00, indicating that the inputs were effectively used to generate the maximum number of ATM transactions per branch and ATM cards issued for the year. Similarly, the estimate of Model 2, which incorporates the number of loan accounts authorized and the number of savings accounts serviced, identified five branches—Padada, Carmen, San Pedro, Calinan, and Mintal—that demonstrated complete technical efficiency ratings. The five branches had a total TE score of 1.00, indicating that the inputs were effectively leveraged to generate the maximum number of loan accounts approved and savings accounts serviced. Both models demonstrated complete technical efficiency in three branches: Padada, Calinan, and Mintal. This indicates that these branches may serve as standards for others to optimize input consumption in order to get the desired output amount for Year 1.

Figure 9 indicates that, according to Model 1 estimate for Year 2, six branches demonstrated complete technical efficiency scores: Bansalan, Sta. Maria, Malita, Calinan, Mintal, Sasa, and Babak. These branches had a complete TE score of 1.00, indicating that the inputs were effectively leveraged to generate the maximum number of ATM transactions per branch and ATM cards issued for the year. Likewise, the Model 2 estimate, which incorporates the number of loan accounts authorized and the number of savings accounts serviced, identified five (5) branches that demonstrated complete technical efficiency ratings. The locations include Padada, Carmen, San Pedro, Calinan, and Mintal. The five branches had a total TE score of 1.00, indicating that the inputs were effectively leveraged to generate the maximum number of loan accounts approved and savings accounts serviced. Both models demonstrated complete technical efficiency in two branches: Calinan and Mintal. This indicates that these branches may serve as standards for others to optimize input consumption in order to get the desired output amount for Year 2.

Figure 10 illustrates that, according to the estimation from Model 1 for Year 3, eight (8) branches demonstrated complete technical efficiency scores: Padada, Sta. Maria, Carmen, Toril, Calinan, Mintal, Sasa, and Babak. The branches demonstrated a complete TE score of 1.00, indicating that the inputs were effectively utilized to generate the maximum number of ATM transactions per branch and the issuance of ATM cards in relation to the year. In a similar analysis, the Model 2 estimation, which incorporates the number of loan accounts granted and the number of savings accounts serviced, identified three (3) branches that demonstrated full technical efficiency scores: Carmen, Calinan, and Mintal. The branches demonstrated a complete TE score of 1.00, indicating that the inputs were effectively utilized to generate the maximum number of loan accounts granted and the number of savings accounts serviced. In the analysis of the two models, it was observed that three (3) branches demonstrated complete technical efficiency across both models: Carmen, Calinan, and Mintal.

This suggests that these branches serve as reference points for other branches to optimize input utilization in order to attain the desired output levels for Year 3.

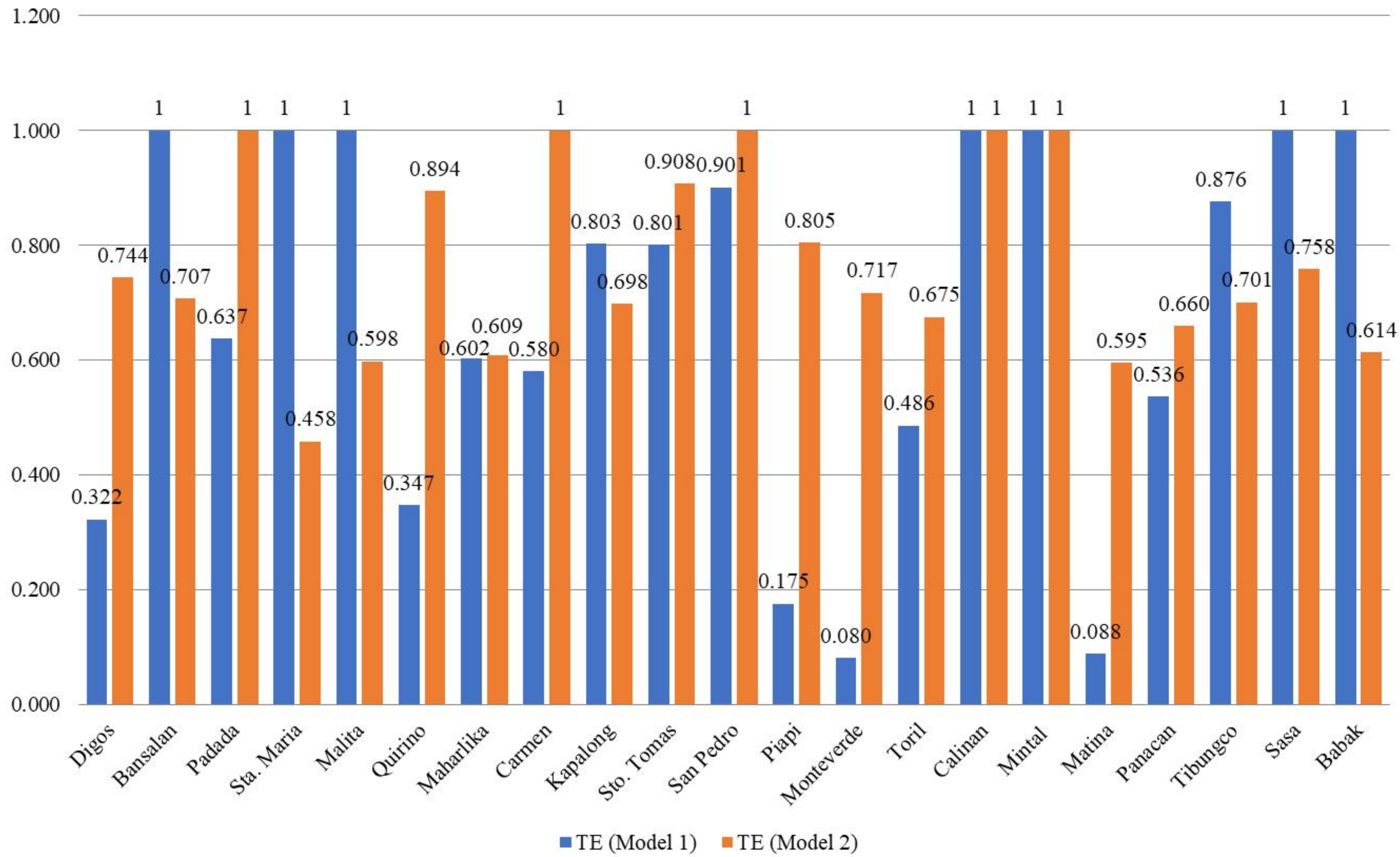

Figure 9. Technical Efficiency (CRS) Scores of Rural Bank's Branches for Year 2

International Journal of Multidisciplinary Studies | Vol 5, No. 1, Dec 2023
ISSN No: 2704-4327 (online)
ISSN No: 2651-768X (print)

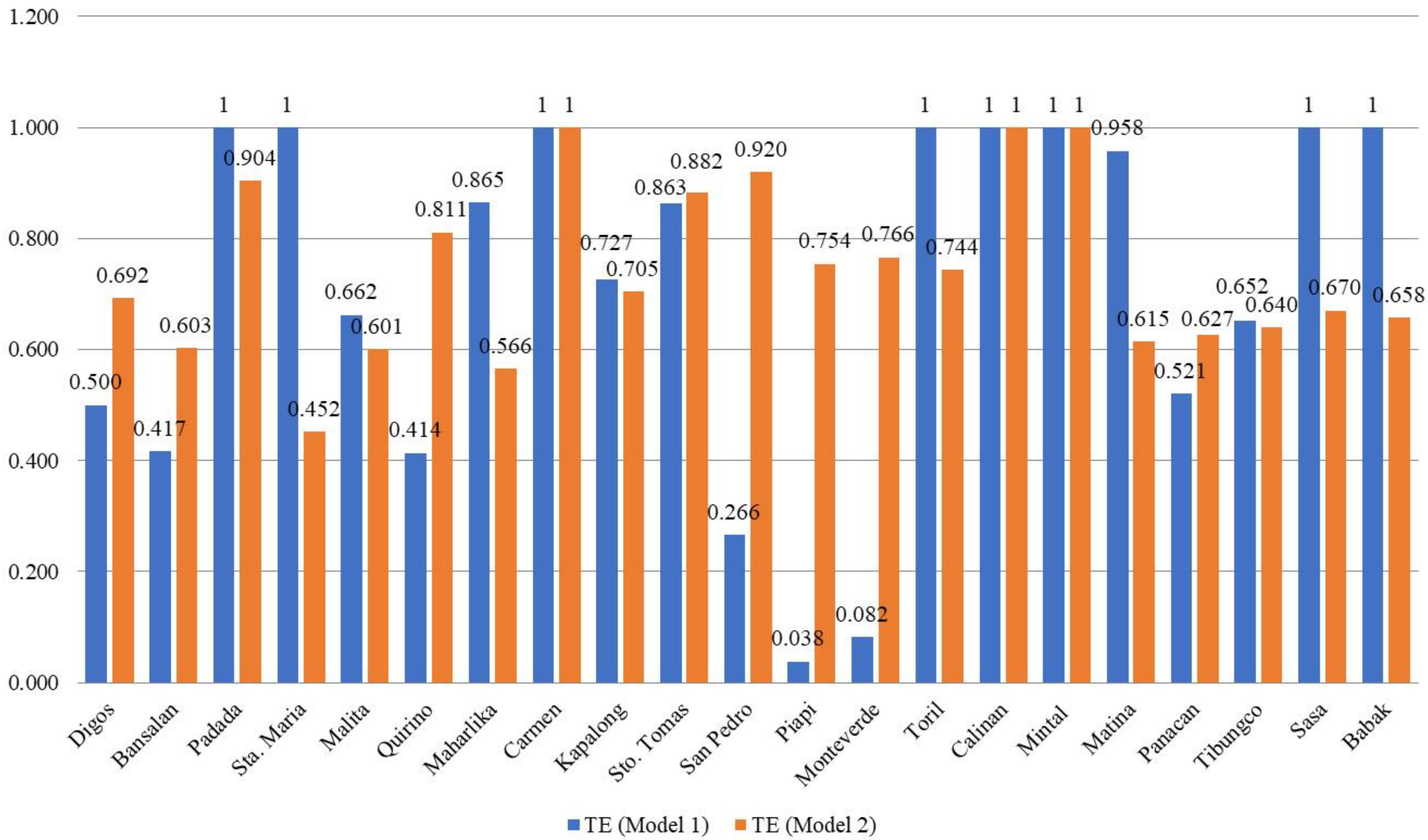

Figure 10. Technical Efficiency (CRS) Scores of the Rural Bank's Branches for Year 3

Optimization of Outputs of Rural Bank's Branches

Improvement strategies for the inefficient branches are proposed by calculating the slack values for each of the factor and consumption variables based on the BCC model. The analysis excluded decision-making units (DMUs) that demonstrated zero slacks. In general, efficient firms that operate on the efficiency frontier exhibit zero slack variables, whereas inefficient firms display non-zero slack variables. Table 1 indicates that 15 branches are recommended to enhance their firm inputs for both Model 1 and Model 2 in order to achieve full technical efficiency scores. To achieve optimum performance under Model 1, San Pedro should consider hiring an additional six personnel, as indicated by the slack of 6.349. It is recommended that floor space be expanded for the following branches in Year 1 to attain optimal efficiency concerning other inputs: Digos should increase by 1 sqm, while Malita and Carmen should each increase by 2 sqm.

Table 1. Inputs, outputs, slacks and new suggestions for inefficient branches (Year 1)

Branch	Model 1			Model 2		
	Personnel	PC	Floor Space	Personnel	PC	Floor Space
Digos	0.000	0.000	0.819	1.763	0.000	0.000
Bansalan	0.000	0.000	0.000	1.532	0.000	0.000
Sta. Maria	***	***	***	0.000	0.478	16.246
Malita	0.000	0.000	2.364	0.000	0.205	0.000
Quirino	0.000	0.000	0.000	0.000	0.896	98.527
Carmen	0.000	0.000	2.482	0.000	0.000	0.000
Sto. Tomas	0.000	0.000	0.000	0.790	0.000	0.000
San Pedro	6.349	0.000	0.000	0.000	0.000	0.000
Monteverde	***	***	***	0.000	0.000	107.518
Toril	0.000	0.000	0.000	0.560	0.000	0.000
Matina	***	***	***	0.000	0.277	50.364
Panacan	0.000	0.000	0.000	0.433	0.000	0.000
Tibungco	0.000	0.000	0.000	0.000	1.302	40.323
Sasa	0.000	0.000	0.000	0.000	0.328	5.256
Babak	0.000	0.000	0.000	0.000	0.000	23.785

*** No estimations for this year

According to the estimations derived from Model 2, it is indicated that the Digos Branch ought to have employed two personnel to enhance its outputs. The Bansalan Branch should similarly consider hiring an equivalent number of personnel, as indicated by a slack value of 1.532 for personnel. Conversely, the Sto. Tomas Branch and Toril Branch ought to have employed one additional staff member in Year 1 to reach an optimal level of output, assuming all other variables remained unchanged. Furthermore, regarding the quantity of PCs or workstations available, Quirino (slack = 0.896) and Tibungco (slack = 1.302) would have benefited from increasing the number of PCs in Year 1 if they aimed to achieve an optimal output level, assuming other factors remain constant. The following branches are advised to expand their floor space to achieve optimal technical efficiency scores: Sta. Maria by 16 sqm, Quirino by 99 sqm, Monteverde by 108 sqm, Matina by 50 sqm, Tibungco by 40 sqm, Sasa by 5 sqm, and Babak by 24 sqm. If the decision-maker had implemented these actions in Year 1, these branches could have positioned themselves on the efficiency frontier.

The variations in efficiency can be attributed to the branches' inability to align their resource deployment with output demands (Aghayi & Maleki, 2016). For example, insufficient staffing in Digos and Bansalan likely contributed to underperformance in service delivery, impacting efficiency. Similarly, inadequate floor space in Sta. Maria and Monteverde may have constrained operational capabilities, limiting the branches' ability to optimize customer transactions and account services. Efficient branches like Calinan and Mintal, which served as benchmarks, demonstrated balanced resource utilization and output alignment, particularly in ATM transactions and loan account processing. These branches provide a model for replicating best practices across the network.

In Year 2, Table 2 indicated that 17 branches are recommended to enhance their firm inputs for both Model 1 and Model 2 to achieve complete technical efficiency ratings. To optimize performance under Model 1, Quirino should employ two more individuals (slack = 1.766). Sto. Tomas and San Pedro must have employed an equivalent number of individuals to maximize their production. Furthermore, to achieve optimal performance, the following branches should employ the specified number of personnel: Piapi increased by 10, Monteverde by 3, Toril by 1, Matina by 1, and Tibungco by 1. It is recommended that the floor space for the following branches be expanded in 2013 to attain optimal efficiency relative to other inputs: Digos by 55 sqm, Carmen by 73 sqm, Maharlika by 22 sqm, Carmen by 34 sqm, Sto. Tomas by 19 sqm, Panacan by 52 sqm, and Tibungco by 33 sqm.

For Model 2, it is recommended that Malita, Piapi, and Sasa obtain an extra PC to enhance their outputs. It is recommended that two PCs/workstations be provided for Quirino, Maharlika, and Kapalong. The following branches are urged to augment their floor space to achieve optimal technical efficiency scores: Sta. Maria by 16 sqm, Quirino by 120 sqm, Monteverde by 98 sqm, Toril by 11 sqm, Matina by 59 sqm, Tibungco by 15 sqm, Sasa by 25 sqm, and Babak by 51 sqm. If the decision-maker had executed these activities in Year 2, these branches may have resided on the efficiency frontier.

The performance of benchmark branches such as Calinan and Mintal underscores their operational stability. These branches likely benefitted from proactive resource planning and optimized workflows, allowing them to maintain full efficiency scores despite system-wide challenges (Tang, 2002; Ting et al., 2022). However, the inefficiencies appear to stem from a mismatch between resource allocation and customer demand (Paradi & Zhu, 2013), as evidenced by the greater slack values. For example, Quirino Branch's inefficiency may be linked to its growing customer base, which outpaced the branch's capacity. Similarly, Tibungco and Monteverde exhibited high slack in floor space, indicating an operational bottleneck caused by inadequate facilities.

Table 2. Inputs, outputs, slacks and new suggestions for inefficient branches (Year 2)

Branch	Model 1			Model 2		
	Personnel	PC	Floor Space	Personnel	PC	Floor Space
Digos	0.000	0.000	55.415	0.000	0.000	0.000
Sta. Maria	0.000	0.000	0.000	0.000	0.458	15.582
Malita	0.000	0.000	0.000	0.000	1.275	0.000
Quirino	1.766	0.000	73.148	0.000	1.738	120.086
Maharlika	0.000	0.000	22.178	0.000	1.668	0.000
Carmen	0.000	0.000	34.941	0.000	0.000	0.000
Kapalong	0.000	0.000	0.000	0.000	1.912	0.000
Sto. Tomas	2.104	0.000	18.821	0.162	0.000	0.000
San Pedro	2.061	0.000	0.000	0.000	0.000	0.000
Piapi	10.279	0.000	0.000	0.000	1.111	0.000
Monteverde	2.959	0.000	0.000	0.034	0.000	98.059
Toril	0.763	0.000	0.000	0.000	0.310	11.064
Matina	0.872	0.000	0.000	0.000	0.265	59.121
Panacan	0.000	0.000	52.282	0.000	0.000	0.000
Tibungco	0.985	0.000	32.816	0.000	0.350	14.720
Sasa	0.000	0.000	0.000	0.000	1.095	24.505
Babak	0.000	0.000	0.000	0.000	0.000	51.056

Finally, for Year 3, Table 3 indicated that 18 branches have been recommended to enhance their firm inputs for both Model 1 and Model 2 to achieve complete technical efficiency ratings. For estimating under Model 1, Malita Branch should have procured an extra PC/computer unit/workstation. Similarly, it is recommended that floor area be expanded for the following branches in Year 3 to attain optimal efficiency concerning other inputs: Bansalan Branch will expand by 8 sqm, Malita Branch by 56 sqm, Quirino by 16 sqm, Kapalong Branch by 17 sqm, Sto. Tomas Branch by 18 sqm, Monteverde Branch by 12 sqm, and Panacan Branch by 14 sqm.

For Model 2, it is recommended that branches of Digos and San Pedro employ extra staff to enhance their outputs. Similarly, branches in Padada, Sta. Maria, Malita, Quirino, Piapi, Toril, and Babak should have procured one more PC each to enhance their outputs, while Maharlika Branch and Kapalong Branch should have obtained two PC units each. The following branches are urged to augment their floor space to achieve optimal technical efficiency scores: Quirino by 89 sqm, San Pedro by 73 sqm, Monteverde by 133 sqm, Toril by 11 sqm, Matina by 61 sqm, Tibungco by 13 sqm, Sasa by 5 sqm, and Babak by 30 sqm. If the decision-maker had undertaken these measures in this period, these branches may have resided on the efficiency frontier.

Table 3. Inputs, outputs, slacks and new suggestions for inefficient branches (Year 3)

DMU	Model 1			Model 2		
	Personnel	PC	Floor Space	Personnel	PC	Floor Space
Digos	0.000	0.000	0.000	0.520	0.000	0.000
Bansalan	0.000	0.000	8.211	0.000	0.058	0.000
Padada	0.000	0.000	0.000	0.000	0.922	0.000
Sta. Maria	0.000	0.000	0.000	0.000	1.058	0.000
Malita	0.000	1.324	56.250	0.000	0.616	0.000
Quirino	0.000	0.000	15.535	0.000	0.811	89.200
Maharlika	0.000	0.000	0.000	0.000	1.551	0.000
Kapalong	0.000	0.000	17.100	0.000	1.932	0.000
Sto. Tomas	0.000	0.000	18.348	0.158	0.000	0.000
San Pedro	0.000	0.000	0.000	0.703	0.000	72.608
Piapi	0.000	0.223	0.000	0.000	1.041	0.000
Monteverde	0.000	0.000	12.194	0.315	0.000	133.498
Toril	0.000	0.000	0.000	0.000	0.579	10.663
Matina	0.000	0.000	0.000	0.000	0.274	61.113
Panacan	0.000	0.000	13.693	0.000	0.373	0.000
Tibungco	0.000	0.000	0.000	0.000	0.320	13.432
Sasa	0.000	0.000	0.000	0.000	0.335	5.361
Babak	0.000	0.000	0.000	0.000	0.950	29.828

The contributing factors to inefficiency in this year include unbalanced resource scaling relative to service demands (Isik & Hassan, 2002), particularly in growing urban areas. For instance, the need for additional PCs in Quirino Branch and Maharlika Branch suggests increasing reliance on automated systems, yet infrastructure did not keep pace. Furthermore, significant slack in floor space for branches such as Monteverde highlights the pressing need for physical expansion to accommodate operational growth (Berger, 2003). Despite these challenges, Calinan and Mintal continued to serve as efficiency benchmarks. Their ability to maintain optimal efficiency scores across all years suggests that these branches consistently aligned their resource deployment with output demands, reinforcing the importance of strategic planning and execution.

CONCLUSIONS

Across the three years, the consistent inefficiencies in personnel, PCs, and floor space underscore the need for a more robust resource allocation strategy. The reliance on slack values to identify specific deficiencies provides actionable insights for optimization. However, the persistence of inefficiencies year-over-year also indicates potential systemic issues, such as inadequate forecasting, uneven demand management, and infrastructural constraints.

Of the 21 branches of the rural bank, this study revealed that on the aspect of technical efficiency, Calinan Branch and Mintal Branch were identified as the best efficiency frontiers for the three periods based on their capacity to have maintained full technical efficiency scores. Padada Branch is included as benchmark for Year 1 while Carmen Branch was included as benchmark for Year 3. In addition, based on the result of summary peer and peer count, the branches in Calinan and Mintal were the best efficiency frontiers, as they served as benchmarks for other branches to arrive on full technical efficiency performance. This implies that these branches may be viewed as the best model branches in terms of having the desirable number of ATM transactions, number of ATM cards released, number of loan accounts granted, and number of savings accounts serviced.

RECOMMENDATIONS

This study highlights actionable strategies for enhancing the technical efficiency of rural bank branches, which, if implemented, can lead to significant benefits for stakeholders. Foremost, branches identified with personnel, infrastructure, and technological deficiencies—such as San Pedro, Piapi, Quirino, and Monteverde—should prioritize resource optimization. Hiring additional staff, expanding floor space, and acquiring more PCs are immediate actions that can address operational bottlenecks. Strategic investments in these areas will improve service delivery, reduce inefficiencies, and position these branches closer to the efficiency frontier.

Moreover, adopting a benchmarking approach is critical. Efficient branches like Calinan and Mintal, which consistently performed as benchmarks, serve as models for others. Their best practices in resource management and operational workflows should be studied and replicated across less efficient branches. To sustain improvements, the bank should institutionalize regular efficiency audits, enabling managers to identify and address inefficiencies dynamically. Integrating data analytics into resource planning and decision-making processes will further enhance the branches' ability to adapt to changing operational demands.

To support these efforts, the bank's central office must establish policies and mechanisms that facilitate infrastructure upgrades and provide adequate financial support for inefficient branches. Additionally, training programs focusing on customer service, resource management, and technological utilization should be implemented to empower employees and improve overall performance. Incentivizing high-performing branches such as Calinan and Mintal can motivate other branches to adopt similar strategies, fostering a culture of continuous improvement.

Finally, fostering customer engagement and collaborating with local authorities can align branch services with community needs and expedite infrastructure enhancements. Developing a multi-year efficiency improvement plan that incorporates sustainable practices—such as energy-efficient technologies and green facility designs—will ensure long-term operational viability and align with broader corporate social responsibility goals. By addressing these recommendations, stakeholders can expect improved customer satisfaction, optimized resource use, and sustained growth for the rural bank network.

REFERENCES

Aghayi, N., & Maleki, B. (2016). Efficiency measurement of DMUs with undesirable outputs under uncertainty based on the directional distance function: Application on bank industry. *Energy, 112*, 376-387.

Apaydin, F., & Çoban, M. K. (2023). The political consequences of dependent financialization: Capital flows, crisis and the authoritarian turn in Turkey. *Review of International Political Economy, 30*(3), 1046-1072.

Asmare, E., & Begashaw, A. (2018). Review on parametric and nonparametric methods of efficiency analysis. *Biostatistics and Bioinformatics, 2*(2), 1-7.

Azad, M. A. K. (2018). Modeling bank efficiency in Malaysia: An adaptive network Data envelopment analysis approach (Doctoral dissertation, University of Malaya (Malaysia)).

Balcerzak, A. P., Kliestik, T., Streimikiene, D., & Smrcka, L. (2017). Non-parametric approach to measuring the efficiency of banking sectors in European Union Countries. *Acta Polytechnica Hungarica, 14*(7), 51-70.

Berger, A. N. (2003). The economic effects of technological progress: Evidence from the banking industry. *Journal of Money, Credit and Banking*, 141-176.

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.

ISSN No: 2704-4327 (online)
ISSN No: 2651-768X (print)

Bhatia, V., Basu, S., Mitra, S. K., & Dash, P. (2018). A review of bank efficiency and productivity. *Opsearch, 55*(3), 557-600.

Botta, A. (2021). Financial liberalisation, exchange rate dynamics and the financial Dutch disease in developing and emerging economies. In *Emerging Economies and the Global Financial System* (pp. 181-196). Routledge.

Casu, B., & Girardone, C. (2004). Large banks' efficiency in the single European market. *The Service Industries Journal, 24*(6), 129-142.

Casu, B., & Molyneux, P. (2003). A comparative study of efficiency in European banking. *Applied Economics, 35*(17), 1865-1876.

Chen, C. C. (2018). ASEAN financial integration and the Belt and Road Initiative: Legal challenges and opportunities for China in Southeast Asia. *International Governance and the Rule of Law in China under the Belt and Road Initiative*, 163-196.

Coelli, T. J., Rao, D. S. P., O'donnell, C. J., & Battese, G. E. (2005). *An introduction to efficiency and productivity analysis*. Springer Science & Business Media.

Estrada, D. A. B., & Cluff, L. D. E. (2023). Structural analysis of banking competition and performance: evidence from the Philippine universal and commercial bank group, 2011-2021 (An Undergraduate Thesis). https://tuklas.up.edu.ph/Record/UP-1685675941122020075?sid=132297818.

Gogovie, F. K. (2019). Corporate Governance, Ownership and Profit Productivity Change: Evidence from Universal Banks in Ghana (Doctoral dissertation, University of Ghana).

Goyal, J., Singh, M., Singh, R., & Aggarwal, A. (2019). Efficiency and technology gaps in Indian banking sector: Application of meta-frontier directional distance function DEA approach*. The Journal of Finance and Data Science*, 5(3), 156-172.

Handoyo, S., Suharman, H., Ghani, E. K., & Soedarsono, S. (2023). A business strategy, operational efficiency, ownership structure, and manufacturing performance: The moderating role of market uncertainty and competition intensity and its implication on open innovation. *Journal of Open Innovation: Technology, Market, and Complexity, 9*(2), 100039.

Isik, I., & Hassan, M. K. (2002). Technical, scale and allocative efficiencies of Turkish banking industry. *Journal of Banking & Finance, 26*(4), 719-766.

Krisciukaityte, K., Balezentis, T., & Streimikiene, D. (2023). Linking financial performance and efficiency to sustainability in banking sector: a literature synthesis. *Journal of Business Economics and Management, 24*(3), 506-526.

Liu, J. S., Lu, L. Y., & Lu, W. M. (2016). Research fronts and prevailing applications in data envelopment analysis. *Data Envelopment Analysis: A Handbook of Empirical Studies and Applications*, 543-574.

Marquis, M. (2018). Competition law in the Philippines: economic, legal, and institutional context. *Journal of Antitrust Enforcement, 6*(1), 79-122.

Meyer, R. (2000). Rural Financial Markets in Asia: Policies Paradigms, and Performance (Vol. 3). Asian Development Bank.

Misra, B. S., & Coccorese, P. (2022). Market power, efficiency and stability of Indian banks. *Economic Change and Restructuring, 55*(4), 2263-2292.

Morelli, M. (2023). Managing Relative Regulatory Inefficiencies in Complex Financial Systems. *U. Pa. J. Bus. L., 25*, 705.

Morrow, R. (2015, March). Regulation: Philippines remains a tough nut to crack. Euromoney. https://www.euromoney.com/article/b12klfxqcsx79d/regulation-philippines-remains-a-tough-nut-to-crack.

Murcia, J. V., Yares, J., Cabilan, R., & Arat, H. L. (2018). Cost efficiency of thrift banks in the Philippines: A data envelopment approach. *International Journal of Management Excellence*, 11(3), 1656–1664. https://doi.org/10.17722/ijme.v11i3.1030.

Omete, F. I. (2023). Financial Intermediation Efficiency and Performance of Commercial Banks Listed on the Nairobi Securities Exchange in Kenya (Doctoral dissertation, JKUAT-COHRED).

Paradi, J. C., & Schaffnit, C. (2004). Commercial branch performance evaluation and results communication in a Canadian bank—a DEA application. *European Journal of Operational Research*, *156*(3), 719-735.

Paradi, J. C., & Zhu, H. (2013). A survey on bank branch efficiency and performance research with data envelopment analysis. *Omega, 41*(1), 61-79.

Rostamzadeh, R., Akbarian, O., Banaitis, A., & Soltani, Z. (2021). Application of DEA in benchmarking: a systematic literature review from 2003–2020. *Technological and Economic Development of Economy, 27*(1), 175-222.

Sandoval, G. L., & Milo, M. M. R. (2018). Regulatory measures affecting services trade and investment: Financial services (No. 2018-40). PIDS Discussion Paper Series.

Shah, A. A., Wu, D., & Korotkov, V. (2019). Are sustainable banks efficient and productive? A data envelopment analysis and the Malmquist productivity index analysis. *Sustainability, 11*(8), 2398.

Tang, K. B. (2002). Robust performance benchmarking: an application of multivariate and data envelopment analysis at the Workers' Compensation Board (Doctoral dissertation, University of British Columbia).

Ting, I. W. K., Chen, F. C., Kweh, Q. L., Sui, H. J., & Le, H. T. M. (2022). Intellectual capital and bank branches' efficiency: an integrated study. *Journal of Intellectual Capital, 23*(4), 840-863.

Vaneman, W. K., & Trianfis, K. (2001, July). Planning for technology implementation: an SD (DEA) approach. In *PICMET'01. Portland International Conference on Management of Engineering and Technology. Proceedings Vol. 1: Book of Summaries* (IEEE Cat. No. 01CH37199) (pp. 375-383). IEEE.

Yang, Z. (2009). Assessing the performance of Canadian bank branches using data envelopment analysis. *Journal of the Operational Research Society, 60*(6), 771-780.

How to cite this article:

Igloria, J. & Yee, E. Jr. (2023)**.** Technical efficiency of a rural bank's branches in Davao Region: A data envelopment approach. *International Journal of Multidisciplinary Studies,* 5(1), 94-122.