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CAMEL MODEL ANALYSIS AND DISCRIMINANT ANALYSIS OF COMMERCIAL BANKS' PERFORMANCE IN GUYANA, SOUTH AMERICA

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ABSTRACT

The study evaluates the performance of commercial banks in Guyana using prudential ratios that capture the five essential dimensions of a bank's operation. It applies the CAMEL rating system and Linear Discriminant Analysis on quarterly prudential ratios of all the commercial banks that operated in Guyana between 2017 and 2021. The CAMEL analysis reveals that Demerara Bank Limited (DBL) is the best-performing bank, and the Guyana Bank for Trade and Industry (GBTI) is the worst-performing bank. However, the one-way ANOVA technique suggests no significant differences between the average values of the prudential ratios in the CAMEL model. Based on the Linear Discriminant Analysis, only four ratios differentiate between good-performing and poor-performing banks. These findings provide valuable insights to regulators that employ these tools to identify poor-performing banks to safeguard the stability and soundness of their domestic banking system. By applying the CAMEL rating system and Linear Discriminant Analysis simultaneously in Guyana, an emerging economy in the Caribbean, for the first time, the study contributes to the literature that utilizes these tools to assess the performance of commercial banks.

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INTRODUCTION

The primary objective of the study is to evaluate the performance of the commercial banks in Guyana by applying the CAMEL rating system and Linear Discriminant Analysis to selected quarterly prudential ratios for the period 2017-2021. These institutions are the main source of finance for private businesses, with assets accounting for more than sixty (60) percent of the total assets of the financial sector (Pasha, 2016). In this regard, commercial banks play a crucial role in the financial services sector by mobilizing savings and allocating them to high-return investments in the private sector that boost economic activities. Historically, these financial institutions have consistently reported capital adequacy ratios above the prudential requirement of eight (8) percent of risk-their weighted assets, relatively high profitability, and excess liquidity and reserves due to the relatively low level of financial intermediation. Consequently, it is understandable that the Guyanese banking system is described as highly capitalized, liquid, and profitable (Pasha, 2016).

Since the discovery of hydrocarbon by Exxon Mobil in 2015, however, the level of financial intermediation has increased, as reflected by the notable growth of credit to the private sector by commercial banks. The exponential growth in lending by commercial banks that is inspired by the rapid transformation of the country's economy may not only create more investment opportunities for commercial banks but also increase the risk exposure, stability, and soundness of these financial institutions. There is a bevy of studies that found that rapid credit growth is associated with banking fragility since it amplifies moral hazard and adverse selection problems (Billings et al., 1996; Fielding & Rewilak, 2015; Ghosh, 2010;

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Schularick & Taylor, 2012). Rapid credit growth also adversely impacts the performance of individual banks and manifests in relatively higher non-performing loans. Khemraj and Pasha (2016) established a positive relationship between rapid credit growth and non-performing loans in Guyana. Similar evidence was found in other countries (Vithessonthi, 2016). It is, therefore, important that the regulatory authority expands its arsenal of supervisory tools to strengthen the supervision of commercial banks, given the unprecedented expansion in credit by the local banking system. By evaluating commercial banks with the CAMEL rating system and Linear Discriminant Analysis, the study will provide valuable insights to regulators in Guyana about the application and robustness of these tools for assessing the performance of these financial institutions.

Currently, there are six (6) commercial banks with numerous branches, of which three (3) are foreign-owned, and three (3) are indigenous banks. Like in other countries, the central bank regulates these institutions through on-site and off-site examinations to protect depositors and ensure the stability and soundness of the financial services sector. The CAMEL rating system is a supervisory tool that has proven useful since the 2008 crisis. This tool was developed in the US in 1979 by the three federal regulatory banking authorities (Daboh & Duramany-Lakkoh, 2023; Kumar & Malhorta, 2017; Roman & Sargu, 2013). According to Bodla and Verma (2006), the CAMEL rating system may help regulators identify banks needing special attention. For the first time in Guyana, this study employs the CAMEL rating tool and Linear Discriminant Analysis to assess the performance of Guyanese commercial banks using selected quarterly prudential ratios of these institutions for the period 2017-2021. The prudential ratios capture the five essential aspects of the commercial banks' performance, often called component factors. These are Capital Adequacy, Asset Quality, Management Efficiency, Earning quality, and Liquidity position.

Since no similar work was done previously in Guyana or the Caribbean, the study will also contribute to the literature. The findings may also be useful for the regulatory authorities responsible for on-site and off-site examinations of commercial banks in the Caribbean. Another important contribution of the paper is that it utilizes the CAMEL approach and Linear Discriminant Analysis simultaneously to evaluate the performance of commercial banks. Since very few studies employ both techniques together, this study will enhance the extant literature.

The remainder of the study is organised as follows. The second section discusses the relevant literature. A description of the objective of the research and methodology follows in the third section. The results of the analysis are presented in the fourth section, and section five concludes with suggestions for future research.

LITERATURE REVIEW

Different academics, scholars, and decision-makers have evaluated the financial performance of the banking industry over the past two decades using the CAMEL framework. In one of the earliest studies, Barker and Holdsworth (1993) found that the CAMEL ratings system is an effective tool for predicting banks' failure and measuring these institutions' performance. Based on similar findings, Barr et al. (2002) argued that the CAMEL rating system is useful for measuring the financial performance of banks by regulators and examiners. Another important finding of Barr et al. (2002) is the strong association between the CAMEL rating and efficiency scores of banking institutions. Gaul and Jones (2021) examined the information content and the determinants of CAMELS rating between 1984 and 2020. They found that the composite ratings have significant predictive power for future bank performance and failures. Using quantile regressions, the study also found that CAMELS ratings convey helpful information regarding the operations and conditions of banks, especially those that are riskier and poorly-performing. More recently, Daboh and Duramany-Lakkoh (2023) employed regression analysis and data for the period 2012-2021 to evaluate the banking sector in Sierra Leone using the CAMEL framework. It found that capital adequacy and earning ability exert a positive and significant effect on the performance of banks. However, asset quality and liquidity management have a negative and insignificant relationship with banks' performance. This section reviews the strand of the literature that utilises the CAMEL approach to examine the relative performance of banks as well as rank the performance of these institutions in various countries.

Venkatesh and Suresh (2014) examined four banks in Bahrain using data from 2006 to 2012 and the CAMELS framework. The government-owned National Bank of Bahrain (NBB) was ranked first overall in terms of capital adequacy, asset quality and liquidity. However, BBK held the first position in terms of management efficiency and liquidity. The authors argued that the findings invalidate the perception that government-owned banks underperform privately-owned banks.

Ab-Rahim et al. (2018) compared the performance of sixty-three listed banks across Malaysia, Singapore, Thailand, and the Philippines between 1997 and 2011. It found that the banks in Singapore outperformed their counterparts in other countries. Notwithstanding, the banks from Thailand and Malaysia were the best performers for capital adequacy and asset quality, respectively. The banks from the Philippines were ranked as the best performers for earnings quality and liquidity.

In Sri Lanka, Rauf (2016) examined the relative performance of a sample of privately-owned and publicly owned banks. The analysis revealed that the privately-owned banks outperformed their publicly owned counterparts in all the parameters of the CAMEL framework. Kumari (2017) applied the CAMEL framework to evaluate the performance of three foreign commercial banks in Sri Lanka over the period 2008-2014. It found that the capital adequacy and earnings of the banks were good but average for the other components of the CAMEL framework.

Al-Najjar and Assous (2021) compared the performance of seven conventional banks with four Islamic banks using the CAMEL framework. The banks obtained different rankings under various parameters. The study extended the literature by estimating a regression model to determine the effects of the CAMEL ranking on the total deposits of Saudi banks. It found that CAR, efficiency ratio, ROE, and the ratio of loans to deposits positively impacted the banks' deposits. In contrast,

the ratios of net income to net revenue and current and savings counts to total deposits (CASA) had the opposite impact on the banks' deposits.

Wirnkar and Tanko (2008) investigated the performance of the largest Nigerian banks using the CAMEL framework. The authors found that no single factor in the CAMEL framework captured the performance of banks completely and therefore argued that regulators utilise the best ratios from the CAMEL framework when evaluating these institutions.

Roman and Sargu (2013) employed the CAMELS framework to examine the financial soundness of 15 commercial banks that accounted for 78.1 percent of the banking sector assets in Romania. The authors used multiple ratios to assess each parameter from the CAMELS framework. The largest bank in the sample, Banca Comerciala Romana, was ranked highly for management quality, earnings, and profitability. However, this bank ranked low based on liquidity. The study also found that the banks in the sample were adequately capitalised.

Altan et al. (2014) investigated the performance of three state-owned banks and twelve private sector banks in Turkey between 2005 and 2012. Using several ratios to represent each component of the CAMEL framework, the study revealed significant differences between state-owned and privately-owned banks, with Ziraat Bank obtaining the best ranking for asset quality and liquidity while Ada bank, Ak bank, and Halk bank obtained the top position in terms of capital adequacy, management quality, earning quality respectively.

Atker (2017) compared the performance of Janata Bank Limited (a public sector bank) with NCC Bank Limited (a private sector bank) using the CAMEL framework and data for the period 2010-2014 in Bangladesh. It found that NCC Bank Limited performed better for all the component factors except Earnings Per Share (EPS) and liquidity ratios. Rahman and Islam (2018) extended this study by using the CAMEL rating system to evaluate seventeen private commercial banks in Bangladesh during the period 2010-2016. It found that the banks' performance and ranking varied based on each component factor of the CAMEL framework. The NCC bank secured the first position on the group average under capital adequacy and asset quality. At the same time, Eastern Bank and One Bank Jamuna Bank were ranked the best under Management Efficiency, Earnings Quality, and Liquidity Management, respectively. The authors argued that the findings could help commercial banks' management formulate policies to improve their financial and overall performance.

Several studies utilized the CAMEL framework to assess the performance of Banks in India. Bodla and Verma (2006), one of the earliest studies to use the CAMEL approach to assess the performance of banks in India, found that State Bank of India (SBI) was superior to ICICI in terms of capital adequacy between 2000 and 2004. However, ICICI outperformed SBI in terms of asset quality, earning quality, and management quality. According to the authors, there was no significant difference in the liquidity positions of the two banks. On the other hand, Mishra and Aspal (2012) assessed the overall performance and economic soundness of the State Bank Group using the CAMEL approach. They concluded that different banks ranked differently based on the CAMEL ratios. However, the authors cautioned that the difference between the CAMEL ratios was not statistically significant based on the ANOVA test. Additionally, the top five private banks in India were considered by Kumar and Malhotra (2017), and their operations were evaluated based on the CAMEL model's parameters. It found that the Axis Bank performed best, and the IndusInd Bank performed worst. Liquidity, revenue capacity, and capital sufficiency were the key reasons for the subpar performance of the latter. Meanwhile, Purohit and Bothra (2018) compared a private sector bank, ICICI Bank, with the State Bank of India (SBI) using CAMEL parameters. The results revealed variations in the performance of the banks based on these parameters. The authors argued that the difference in the parameters reflected SBI's efforts to improve its efficiency, revenue, and liquidity, as well as the attempts by the ICICI Bank to strengthen its capital adequacy and asset quality. More recently, Kumar, Christy, and Raja (2022) evaluated the financial performances of selected private banks in India using the CAMEL Model. The observation period spans five years, starting from 2017 to 2021. The study found that the CAMEL framework aided in determining a bank's overall performance based on key prudential ratios such as capital adequacy, asset quality, management efficiency, earnings quality, and liquidity.

Even with the widespread application of the CAMEL approach in assessing the financial performance of commercial banks, the technique has limitations. For instance, Wirnkar and Tanko (2008) argued that no one factor in the CAMEL framework captures a bank's overall performance. Unsurprisingly, academics have complemented the CAMEL framework with analytical tools such as regression analysis, while others assessed the performance using CAMEL ratios and alternative techniques. Echekoba et al. (2014) examined the profitability of commercial banks in Nigeria using the CAMEL rating model and regression analysis. The study found that only liquidity management is significantly related to the performance of commercial banks, while the other factors are not. Using regression analysis and the CAMEL framework, Muhmad and Hashim (2015) revealed that capital adequacy, asset quality, and liquidity significantly impacted Malaysian banks' performance when Return on Assets is used as the dependent variable in the regression model. However, only asset quality and earning quality impacted their performance when the model used Return on Equity as the dependent variable. Ngoboka and Gatauwa (2020) employed the CAMEL rating systems and panel regression analysis to examine the financial performance of commercial banks in Rwanda. The study found that financial performance has a significant positive relationship with capital adequacy and asset quality and a significant negative relationship with management efficiency. When bank size is used as an independent variable, the relationships between bank performance and the CAMEL ratios are altered. This means that relationships between bank performance and the CAMEL ratios are sensitive to the model's functional form. Nair et al. (2018) compared the performance of privately owned banks with those owned by the government using the CAMEL framework and Discriminant Analysis. The study showed that the Debt-to-Equity ratio, Tier I capital ratio), net NPA ratio, and sensitive sector loans to total loans ratio explained the variation in the performance between these two categories of banks in India. Derviz and Podpiera (2008) investigated whether the CAMEL rating can predict the long-run S&P rating of banks in the Czech Republic using panel data and an ordered probit model. It found that capital adequacy,

credit spread, the ratio of loans to total loans, and value-at-risk for total assets and leverage are good predictors of the S&P rating. Gasbarro et al. (2002) employed panel models to examine the changing banking soundness of commercial banks in Indonesia during the Asian Financial Crisis. The study found that during this crisis, only one component of the CAMEL framework, earnings, discriminated among the ratings of the bank. In an attempt to identify gaps in the extant literature that utilized the CAMEL framework to assess the performance of banks, Maude and Dogarawa (2016) argued that the extant literature is mainly descriptive and only a few studies explore the relationship between CAMEL ratios and bank performance. According to the authors, there is also a paucity of research in emerging countries, especially with new economic situations.

MATERIALS AND METHODS

The study utilizes quarterly prudential ratios of all the commercial banks during the period 2017-2021. The banks include Republic Bank (Guyana) Limited (RBL), Bank of Baroda, Bank of Nova Scotia (BNS), Guyana Bank for Trade & Industry Limited (GBTI), Demerara Bank Limited (DBL), and Citizens Bank (Guyana) Incorporated (CBI). The first three banks are foreign-owned, and the others are indigenous. The prudential ratios that cover the five dimensions of the CAMEL framework (Capital Adequacy, Asset Quality, Management Efficiency, Earnings Quality, and Liquidity) are discussed below.

Capital Adequacy determines whether a bank has sufficient capital to absorb unexpected losses from investing in risky assets. In Guyana, commercial banks are required to always maintain a minimum unimpaired paid-up capital of $250 million. Additionally, these institutions are required to maintain a minimum capital adequacy ratio (CAR) of at least eight (8) percent, computed by dividing the total eligible capital of these institutions by their total risk-weighted assets (RWA). This study utilizes the CAR to assess the performance of the banks since it is used extensively in the literature (Al-Najjar & Assous, 2021; Ab-Rahim et al., 2018; Altan et al., 2014; Atker, 2017; Kumar et al., 2022; Mishra & Aspal, 2012; Rauf, 2016; Roman & Sargu, 2013; Venkatesh & Suresh, 2014). According to Lad and Ghorpade (2022), banks with high capital adequacy ratios can satisfy their obligations, while those with low ratios are likely to face bankruptcy. Prior studies have also established that capital adequacy ratios impact bank performance (Derviz & Podpiera, 2008; Muhmad & Hashim, 2015; Ngoboka & Gatauwa, 2020; Nair et al., 2018).

Since loans account for a large share of commercial banks' assets, these institutions need to pay keen attention to the quality of their loan portfolios. The loans that are not performing (referred to as non-performing loans) could undermine the earning capacity of banks as well as erode their capital, which in turn may result in the insolvency of these institutions (Hou, 2007; Kane & Rice, 2001). Therefore, the quality of commercial banks' loan portfolios is an important parameter of their financial strength (Frederick, 2012). Supervision Guideline No. 5 of the Bank of Guyana places the credit facilities of banks into the following categories: pass, special mention, substandard, doubtful, and loss. This study evaluates the asset quality of commercial banks using the ratio of non-performing loans to total loans. Several studies have utilised this ratio (Altan et al., 2014; Atker, 2017; Roman & Sargu, 2013; Venkatesh & Suresh, 2014) and found it had a significant relationship with bank performance (Derviz & Podpiera, 2008; Muhmad & Hashim, 2015; Ngoboka & Gatauwa, 2020; Nair et al., 2018).

Management efficiency is essential for commercial banks' survival and long-term viability and stability (Ayayi & Sene, 2010; Ghosh & Sanyal, 2019). It is not surprising that management efficiency is considered when determining the performance of banks based on the CAMEL framework. Indeed, management efficiency has been found to have a significant relationship with the financial performance of banks (Getahun, 2015). This aspect of a bank's performance can be evaluated using a variety of qualitative and quantitative factors. To a large extent, some of the qualitative factors the regulatory authority considers regarding the management of local banking institutions are covered in Supervision Guideline No. 8 of the Bank of Guyana. The ratio of operating expense to total income is a traditional proxy for measuring management efficiency (Shah & Jan, 2014). This study uses the expense ratio to assess the relative efficiency of commercial banks.

Earnings quality is an important factor to examine when assessing the performance of banks based on the CAMEL framework since earnings determine the internal capital formation and asset growth of banking institutions as well as their stability (Adem, 2022). There are numerous ratios for assessing the earnings quality of banks, but two of the most frequently used measures are Return on Assets (ROA) and Return on Equity (REO) (Al-Najjar & Assous, 2021; Altan et al., 2014; Atker, 2017; Dincer et al., 2011; Mishra & Aspal, 2012; Roman & Sargu, 2013; Venkatesh & Suresh, 2014). In this study, the return on assets (ROA) is used and computed by dividing the bank's operating income by its total assets. Like the other components of the CAMEL framework, earnings quality has been found to impact the performance of banks significantly (Frederick, 2012; Getahun, 2015; Muhmad & Hashim, 2015).

Liquidity, which refers to the ability of banks to meet their liabilities when they fall due (Gul Zeb, 2011), is another important component of the CAMEL framework. In Guyana, commercial banks are required to maintain liquidity ratios that equate to 20 percent of demand liabilities and 15 percent of time liabilities. The regulator sets these ratios to ensure that the commercial banks maintain sufficient liquid assets to satisfy the demand for cash by depositors whenever needed. While too little liquidity can trigger insolvency, too much can result in lower profitability (Kumar & Malhorta, 2017). The ratio of liquid assets to total assets is a good measure of the liquidity position of commercial banks and is used in this study. Several studies have employed this ratio (Altan et al., 2014; Atker, 2017; Ab-Rahim et al., 2018; Dincer et al., 2011; Mishra & Aspal, 2012; Rauf, 2016). It is also important to note that liquidity is significantly related to bank performance (Echekoba et al., 2014; Muhmad & Hashim, 2015).

The study applies the CAMEL rating system to the ratios described above, a tool that is widely used for assessing the overall performance of commercial banks. With this technique, each bank is ranked based on the average value for each component factor. The bank with the highest average value for Capital Adequacy, Earnings Quality and Liquidity is ranked

the best, followed by the bank with the second highest score, and so on. However, the bank with the lowest average ratio for Asset Quality and Earnings is ranked the best, followed by the second lowest value, and so on. The average ranking is then computed to determine the overall ranking of the banks.

The study also employs Linear Discriminant Analysis (LDA) to identify the linear combination of prudential variables that differentiate between good-performing and bad-performing banks. This technique was utilised by Altman (1968) to predict firm failure. Mous (2005) also employed the same technique to predict bank failure. The discriminant function is generally defined thus:

$$D = v_0 + X_1 v_1 + X_2 v_2 + X_3 v_3 + \cdots + X_p v_p \quad (1)$$

Where, D is the dependent or grouping variable, $X_1, X_2, X_3, \ldots, X_p$ are the explanatory variable and $v_0, v_1, v_2, v_3, \ldots, v_p$ are the corresponding estimated discriminant coefficients that can be used to predict the value of the dependent variable. In this two-group case, the discriminant function is defined specifically as follows:

$$D = v_0 + X_1 v_1 + X_2 v_2 + X_3 v_3 + X_4 v_4 + X_5 v_5 \quad (2)$$

Where,
D = The discriminant function for the dependent or grouping variable, good or poor performing banks. The banks are classified based on their ranking from the CAMEL approach. Those with ranking above the average are classified as good-performing banks while those below are classified as poor-performing banks.
X_1 = eligible capital divided by risk-weighted assets
X_2 = non-performing loans divided by total loans
X_3 = operating expense divided by total income
X_4 = operating income divided by total assets
X_5 = liquid assets divided by total assets
v_1, v_2, v_3, v_4, and v_5 are the corresponding estimated discriminant coefficients.

The study utilizes the Wilks Lambda to determine the validity of the discriminant analysis. A Wilks Lambda that is close to zero and statistically significant (i.e., less than 5 percent) suggests that discriminant analysis effectively differentiates the two groups. Once discriminant analysis is determined to be suitable, the discriminant function is estimated, and the various significance tests are performed. The Tests of Equality of Means are applied to ascertain the significance of each predictor, while the strength of the function is evaluated with the eigenvalue and canonical correlation. Predictors with p-values less than 10 percent are considered significant and therefore retained, while those with p-values above 10 percent are removed to derive the parsimonious. Eigenvalues higher than one and canonical correlation above 0.75 suggest a high degree of association between the discriminant score and the group, and the model is robust. The canonical correlation is akin to the R-square in regression analysis.

The unstandardized coefficients of the parsimonious function are utilized to generate the discriminant score of each bank that is compared with the group Centroid scores. If the discriminant score of a bank is more than the Centroid, then the bank comes from Group 1 (Good-performing bank), and if the Discriminant score for a bank is below the Centroid, it comes from Group 2 (Poor-performing bank).

As with multiple regression analysis, the predictors are assumed to be not highly correlated in the discriminant function. The Variance Inflation Factor (VIF) is computed for the predictors to ensure this assumption is not violated. Where the VIF is less than 10, multicollinearity is not a problem. The Box's M test is also performed to determine whether the assumption of homogeneity of the variance-covariance matrices is not violated. An alpha value of more than 0.001 for the Box's M test means that the assumption of equality of covariance matrices has not been violated, and one can proceed with the discriminant analysis. The Normality assumption of each predictor is tested by applying the Normal P-P plot for each predictor. Finally, the function is examined to determine how well it classifies each group correctly.

DISCUSSIONS

Results from the CAMEL rating system: The results from analysing the selected CAMEL ratios are discussed in this section.

Capital Adequacy

The commercial banks' capital adequacy ratio (CAR) displayed mixed performance during the review period. The CAR ratio for RBL and BOB trended upwards, while it declined for GBTI and DBL between 2017 and 2021. The ratio oscillated for BNS and CBI during the corresponding period. Notwithstanding, all the commercial banks reported capital adequacy ratios well above the Regulatory requirement level of 8 percent. It, therefore, means that all the banks maintained adequate capital to absorb unforeseen losses and avoid bankruptcy in the future.

Table 1. Capital Adequacy Ratio (%)

Year	RBL	GBTI	BNS	DBL	CBI	BOB
2017	19.12	31.61	27.77	33.96	27.62	43.62
2018	21.75	29.88	30.57	32.48	30.25	52.07

2019	22.61	29.36	27.71	30.04	27.08	67.90
2020	22.42	31.25	29.42	30.49	26.46	66.08
2021	23.99	26.71	29.56	28.03	29.47	59.10
Average	21.98	29.76	29.01	31.00	28.18	57.75
Rank	**6**	**3**	**4**	**2**	**5**	**1**

As per Table 1, BOB is in the top position with the highest group average CAR of 57.75, followed by DBL with a group average CAR of 31.0. RBL was the lowest-ranked bank, with a group average of 21.98.

Asset Quality

The ratio of non-performing loans to total loans of all the commercial banks trended downwards, suggesting an improvement in the asset quality of these institutions. This may be attributed to the improvement in the economy between 2017 and 2021. Table 2 shows that DBL is the best-ranked bank with the lowest group average ratio of non-performing loans to total loans of 1.85, followed by RBL with a group average of 2.18. The lowest-ranked commercial bank was GBTI, with a group average of 10.99.

Table 2. Non-performing loans to total loans (%)

Year	RBL	GBTI	BNS	DBL	CBI	BOB
2017	2.68	11.91	5.68	2.74	8.99	8.57
2018	2.44	11.91	6.62	2.30	6.65	10.15
2019	2.00	11.84	7.19	1.62	5.95	13.24
2020	1.82	10.89	5.63	1.41	4.57	9.56
2021	1.95	8.43	4.22	1.18	3.44	6.79
Average	2.18	10.99	5.87	1.85	5.92	9.66
Rank	**2**	**6**	**3**	**1**	**4**	**5**

Management Efficiency

Which is important for a bank's long-term growth and survival, was mixed during the years 2017-2021. Management efficiency, measured by the ratio of operating expenses to operating income, fluctuated for GBTI, RBL, and CBI. However, the ratio exhibited a general downward trend for BNS and steadily increased for BOB during the review period.

Table 3. Operating expenses to operating income (%)

Year	RBL	GBTI	BNS	DBL	CBI	BOB
2017	68.34	63.97	64.12	64.39	70.91	44.37
2018	66.05	65.80	66.16	67.29	73.39	54.03
2019	66.54	63.96	65.68	65.02	72.47	54.53
2020	70.25	65.51	64.88	67.49	76.20	56.58
2021	67.26	63.77	59.86	69.45	72.42	58.83
Average	67.69	64.60	64.14	66.73	73.08	53.67
Rank	**5**	**3**	**2**	**4**	**6**	**1**

Table 3 shows that BOB is the best-ranked commercial bank with the lowest average expense ratio of 53.67, followed by BNS, GBTI, DBL, and RBL with average expense ratios of 64.14, 64.60, 66.73, and 67.69, respectively. The lowest-ranked bank was CBI, with an expense ratio of 73.08.

Earning Quality

As noted earlier, the quality of earnings is a crucial criterion because it demonstrates a bank's profitability and explains the sustainability and growth of its future earnings. In this study, the ROA is used to measure the earning quality of commercial banks in Guyana. The profitability ratio trended downward for RBL and BOB, suggesting that the earnings quality of these banks deteriorated during the review period. Conversely, the ROA displayed a general upward trend for CBI while it fluctuated for BNS and DBL.

Table 4. Return on Asset (%)

Year	RBL	GBTI	BNS	DBL	CBI	BOB
2017	4.62	2.72	4.79	5.49	2.28	4.34
2018	4.86	2.22	4.41	5.81	2.33	2.19
2019	4.73	2.30	5.26	5.80	2.31	1.93
2020	3.41	2.02	2.45	4.91	2.44	1.58
2021	3.59	2.32	3.54	5.88	2.82	0.81
Average	4.24	2.32	4.09	5.58	2.44	2.17
Rank	**2**	**5**	**3**	**1**	**4**	**6**

Table 4 shows that DBL is the best-performing bank with an average ROA of 5.58, followed by RBL, BNS, CBI, and GBTI with average ROAs of 4.24, 4.09, 2.44, and 2.32, respectively. With an average ROA of 2.17, BOB is ranked the

lowest-performing bank.

Liquidity

The ratio of liquid assets to total assets, which indicates a bank's capacity to fulfill its financial obligations, is a key performance indicator. When a bank can satisfy all its financial obligations as they fall due, it is considered adequately liquid. Except for DBL, the liquidity ratios of the commercial banks displayed a general upward trend.

Table 5. Liquid assets to total assets (%)

Year	RBL	GBTI	BNS	DBL	CBI	BOB
2017	30.91	30.79	31.85	72.10	36.02	36.46
2018	35.53	28.56	32.03	66.53	40.12	37.50
2019	32.46	29.73	38.66	66.40	40.04	36.58
2020	43.21	32.50	51.84	69.49	41.80	49.41
2021	41.31	32.79	50.12	68.53	48.26	43.32
Average	36.68	30.87	40.90	68.61	41.25	40.65
Rank	5	6	3	1	2	4

Table 5 shows that DBL is in the top position with an average ratio of liquid assets to total assets of 68.61, followed by CBI, BNS, BOB, and RBL with average ratios of 41.25, 40.90, 40.65, and 36.68, respectively. GBTI was ranked the lowest, with an average ratio of liquid assets to total assets of 30.87.

Overall Ranking

To assess the overall performance of the private sector banks, an aggregate rating is calculated, and the results are shown in Table 6 for the study period 2017-2021. It is observed that the capital adequacy ratio of BOB is at the upper position and RBL at the lower position. With respect to the asset quality parameter, DBL is ranked first, while RBL is in 2nd position, and GBTI is in the lowest position at 6th. Concerning the management efficiency parameter, it is observed that BOB ranks highest while BNS is in the 2nd position, and CBI is in the 6th or lowest position. Regarding the earnings capacity parameter, DBL ranked first, while RBL is ranked 2nd and BOB ranked 6th position. Under the liquidity parameter, DBL is the top performer, followed by CBI while GBTI bank was ranked as the worst performer. The analysis revealed that DBL is ranked first with an overall average rank of 1.8, followed by BNS with an average rank of 3. BOB, RBL, and CBI are ranked 3rd, 4th, and 5th, respectively. GBTI is positioned at last with an overall average score of 4.6.

Table 6. Overall Ranking

Ratios	RBL	GBTI	BNS	DBL	CBI	BOB
C	6	3	4	2	5	1
A	2	6	3	1	4	5
M	5	3	2	4	6	1
E	2	5	3	1	4	6
L	5	6	3	1	2	4
Average	4.00	4.60	3.00	1.80	4.20	3.40
Rank	4	6	2	1	5	3

ANOVA Result

A one-way ANOVA test was used to determine if significant differences existed between the average values of the CAMEL ratios. The ANOVA test results showed that the calculated value of the F ratio (0.726) is lower than the table value (2.621) with df (5, 24) at 5% significance level, p-value = 0.610 > 0.05). This means there is no statistically significant difference between the average values of the CAMEL ratios, so the null hypothesis is accepted. It also shows no significant difference in the performance of the Private Sector Banks under the CAMEL model. CAMEL ratios with the data given in Table 6. The results of the one-way ANOVA test are shown in Table 7.

Table 7. One-way ANOVA

Items	Sum of Squares	df	Mean Square	Mean Square	F	Sig.
Between Groups	11.500	5	2.300	2.300	.726	.610
Within Groups	76.000	24	3.167	3.167		
Total	87.500	29				

Results: Discriminant Analysis Approach

The ANOVA test revealed no significant difference between the prudential ratios based on the CAMEL model. The authors made an attempt to classify the six private sector banks into Performance Ratings. The experiment is designed as banks are initially grouped as good performing banks and poor performing banks. A discriminant analysis is performed, and the model, results, and interpretations are presented as follows.

As explained earlier, the suitability of the Linear Discriminant Analysis is examined using Wilks' Lambda. The Wilks' Lambda value is 0.263 and statistically significant at the 1 percent level of significance (see Table 8), suggesting

that discriminant analysis is very effective in differentiating between the two groups, good-performing, and poor-performing banks.

Table 8. Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1	.263	34.096	5	.000

From Table 9, we observe that the average CAMEL ratios of the good-performing banks are superior to the average ratios of the poor-performing banks. In particular, the average Capital Adequacy, Earnings Quality, and Liquidity ratios of the good-performing banks are higher than the average for the poor-performing banks. Conversely, the average Asset Quality and Management Efficiency ratios for the good-performing banks were lower than the poor-performing banks (see Table 9).

Table 9.Group Statistics

Performance of the Banks		Mean	Std. Deviation	Valid N (List wise)	
				Unweighted	Weighted
Good Performance	Capital Adequacy	39.253333	14.6632881	15	15.000
	Asset Quality	5.791833	3.6050497	15	15.000
	Management Efficiency	61.510833	6.7752033	15	15.000
	Earning Quality	3.945833	1.7262288	15	15.000
	Liquidity	50.052333	14.8868675	15	15.000
Bad Performance	Capital Adequacy	26.638667	3.8515158	15	15.000
	Asset Quality	6.363500	3.9939406	15	15.000
	Management Efficiency	68.455000	3.9141114	15	15.000
	Earning Quality	2.997333	.9982715	15	15.000
	Liquidity	36.267167	5.8521059	15	15.000
Total	Capital Adequacy	32.946000	12.3334704	30	30.000
	Asset Quality	6.077667	3.7495850	30	30.000
	Management Efficiency	64.982917	6.4828472	30	30.000
	Earning Quality	3.471583	1.4670773	30	30.000
	Liquidity	43.159750	13.1402969	30	30.000

Having determined that discriminant analysis is suitable, the discriminant function is estimated with selected CAMEL ratios used to rank the performance of the commercial banks. Among the five prudential ratios that we have considered, Asset Quality failed the tolerance test. Hence, in our further analysis and modelling, we only include Capital Adequacy, Management Efficiency, and Liquidity with p-values below 0.01 and Earning Quality with p-value below 0.10 (see Table 10).

Table 10. Tests of Equality of Group Means

Items	Wilks' Lambda	F	df1	df2	Sig.
Capital Adequacy	.729	10.385	1	28	.003*
Asset Quality	.994	.169	1	28	.684
Management Efficiency	.703	11.814	1	28	.002*
Earning Quality	.892	3.394	1	28	.076**
Liquidity	.715	11.140	1	28	.002*

Note: * indicates significant at 1% level and ** indicates significant at 10% level.

The eigenvalue, which measures the proportion of the variance explained by the function, is greater than 1, suggesting that the estimated function is robust (see Table 11). The Canonical Correlation of 0.859 confirms that the discriminant function discriminates well (see Table 11).

Table 11. Eigenvalues

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	2.808[a]	100.0	100.0	.859

First 1 canonical discriminant functions were used in the analysis.

Table 11 shows that the Variance Inflation Factor (VIF) for each variable is below 10. This indicates that the model does not suffer from multicollinearity. Additionally, the homogeneity assumption of the variance-covariance matrices is not violated based on the Box's M Test. According to Table 13, the Box's M value is 9.832. The F value (0.5356), which is not significant at the 1% level of significance (p-value (0.069) > 0.01).

Table 12. Summary Statistics

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	2.007	1.206		1.664	.109		
	Capital Adequacy	-.020	.009	-.478	-2.284	.031	.250	4.004
	Asset Quality	-.012	.025	-.088	-.471	.642	.312	3.205
	Management Efficiency	.021	.014	.271	1.555	.133	.359	2.784
	Earning Quality	-.159	.062	-.458	-2.567	.017	.344	2.906
	Liquidity	-.014	.006	-.370	-2.230	.035	.398	2.510

a. Dependent Variable: Performance of the Banks

Table 13. Box's M Test Results

Box's M		9.832
F	Approx.	.5356
	df1	15
	df2	3156.632
	Sig.	.069

Tests null hypothesis of equal population covariance matrices.

The Normality assumption of each predictor is tested and valid since the Normal P-P plot for each predictor shows that the data follows fairly Normal distribution (see Figure 1).

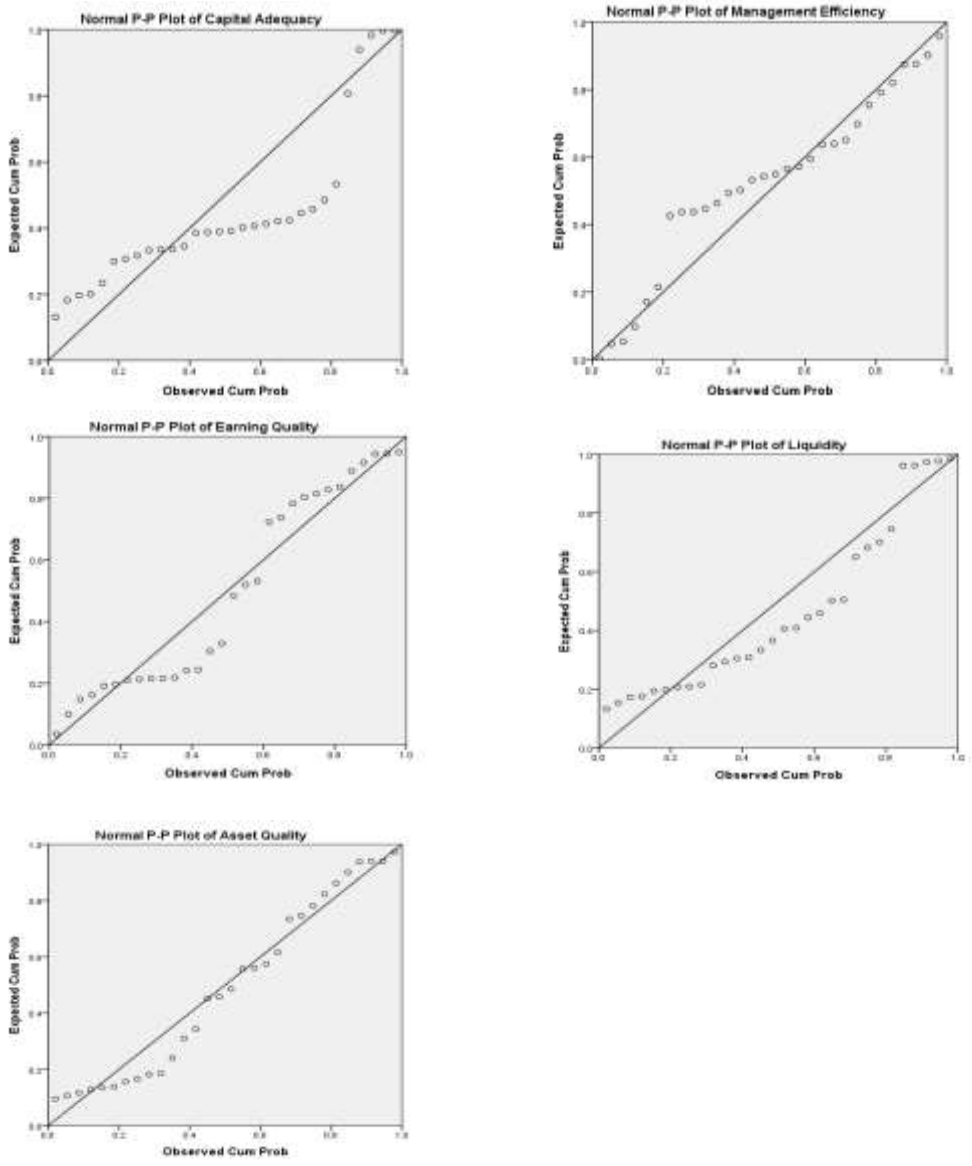

Figure 1. Normal P-P plots for Independent Variables

The function is further interrogated to determine how well it predicts poor-performing and good-performing banks. Based on the results, the function classifies 90 percent of the original grouped cases correctly, of which 80 percent of the good-performing banks and 100 percent of the poor-performing banks are correctly satisfied (see Table 14). It, therefore, means that there is a 0.20 probability that the function commits a type 1 error and a zero probability it commits a type 2 error.

Table 14. Classification Results

		Performance of the Banks	Predicted Group Membership		Total
			Good Performance	Bad Performance	
Original	Count	Good Performance	12	3	15
		Bad Performance	0	15	15
	%	Good Performance	80.0	20.0	100.0
		Bad Performance	.0	100.0	100.0

90.0% of original grouped cases correctly classified.

The discriminant score for each bank is computed using the equation below based on the discriminant function coefficients computed in Table 15.

Table 15. Canonical Discriminant Function Coefficients

					95% Confidence Interval	
		Coefficient	Bias	Std. Error	Lower	Upper
Asset Quality	1	.053	.019	.121	-.161	.314
Capital Adequacy	1	.087	.012	.067	-.010	.271
Earning Quality	1	.697	.130	.530	-.146	2.078
Liquidity	1	.063	.002	.068	-.096	.209
Management Efficiency	1	-.093	-.001	.122	-.299	.289
(Constant)	1	-2.226	-.948	8.467	-22.970	10.892

$$D = 2.226 + 0.087 * Capital\ Adequacy + 0.063 * Liquidity + 0.697 * Earning\ Quality - 0.093 * Management\ Efficiency \quad (3)$$

The discriminant score is compared with the $\text{Group Centroid} = (1.619 - 1.619)/2 = 0$. Any bank which has a discriminant value above zero comes from the group of good-performing banks while any bank with a Discriminant value below zero comes from the group of poor-performing banks.

Table 16. Functions at Group Centroids

Performance of the Banks	Function
	1
Good Performance	1.619
Bad Performance	-1.619

Unstandardized canonical discriminant functions evaluated at group means.

The overall Discriminant Score with the rankings and Group classification are presented in the Table below. From Table 17, the best-performing banks are BNS, DBL, and BOB, with discriminant scores above 0, while the poor performers are RBL, GBTI, and CBL, with discriminant scores below 0. The best performer is DBL with the highest discriminant score (2.475), followed by BOB (1.881), BNS (-0.240), RBL (-1.343), GBTI (-1.602), and CBL (-2.274).

Table 17. Discriminant Score, Bank Classification and Ranking

Bank	Discriminant Score	Bank Classification	Ranking
RBL	-1.342661	Poor Performing	4
GBTI	-1.602257	Poor Performing	5
BNS	-0.2402725	Poor Performing	3
DBL	2.4752725	Good Performing	1
CBL	-2.2742185	Poor Performing	6
BOB	1.881226	Good Performing	2

CONCLUSIONS

The study applies the CAMEL rating tool Guyana to quarterly prudential ratios of these institutions for the period 2017-2021 to assess the performance of the six commercial banks in Guyana. While numerous researchers have applied the CAMEL approach to gauge the financial performance of banks in various countries, this was never done before in Guyana. The CAMEL analysis ranks DBL as the best performing bank with an overall average rank of 1.8, followed by BNS with an average rank of 3. BOB, RBL, and CBI are ranked 3rd, 4th, and 5th, respectively. GBTI is worst performing banks with

an overall average score of 4.6 according to the CAMEL approach. The one-way ANOVA test finds that there is no statistically significant difference between the average values of the prudential ratios.

Linear Discriminant Analysis shows that the prudential ratios differentiate between good and poor performance among the banks. The Wilks' Lambda test reveals that the LDA is suitable. However, the results show that only four of the five prudential ratios explain variations in the performance of the banks. According to the results, the function classifies 90 percent of the original grouped cases correctly, of which 80 percent of the good-performing banks and 100 percent of the poor-performing banks are correctly classified. It, therefore, means there is a 0.20 probability that the function commits a type 1 error and a zero probability it commits a type 2 error. Further, the discriminant scores suggest that DBL is the best-performing bank, whereas CBL is the worst-performing bank. Based on the various diagnostic tests, the discriminant function did not violate the assumptions of normality, homogeneity of the variance-covariance matrices, and multicollinearity.

The study's limitations included the number of commercial banks operating in Guyana. There are only six banks, and all are privately owned. There is no opportunity to compare the performance of privately and publicly owned banks. Also, a limited number of prudential ratios were available for analysis. Further, we encountered two conflicting results from the CAMEL approach and the Linear Discriminant Analysis.

Therefore, future research should continue the investigation using the more versatile Bayesian method to resolve conflict. A study of this nature will also extend the literature since no previous work employed the Bayesian method to investigate the performance of banks in Guyana and the Caribbean.

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