

# Determinants of Capital Adequacy Ratio of Banks in Botswana

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## Abstract

Capital Adequacy Ratio (CAR) plays a very important role in the financial success of banks and acts as a buffer to prevent and absorb any unexpected losses. This study examines explanatory variables that influence CAR for nine banks in Botswana. Multiple linear regression was used for analysis, with CAR as the dependent variable and thirteen financial ratios as the independent variables. The study period is 2015-2019. Based on the data for this period, it was established that out of the thirteen financial ratios utilised, only four were found to have significant impact on the CAR of the nine banks under study, which are: Asset to Equity Ratio (A\_E), Return on Equity (ROE), Non-Performing Loans Ratio (NPL\_RATIO) and the Cost-to-Income Ratio (C\_I). The A\_E Ratio was found to be the most influential driver of the CAR and the NPL\_Ratio was found to be the least influential driver of the CAR for the banks under study.

**Keywords:** capital adequacy ratio, multiple linear regression, Botswana

## 1. Introduction

Capital adequacy ratio is an important measure of “Safety and Soundness”, hence sufficient capital is required by banks as it acts as a buffer to prevent and absorb any unexpected losses. Mishkin (2013) states that banks have to make decisions about the amount of capital they need to hold for the following three reasons:

- Bank capital helps to prevent bank failure,
- The amount of capital affects returns for the owners (equity holders) of the bank, and
- A minimum amount of bank capital (bank capital requirements) is required by bank authorities.

Capital adequacy ratio refers to the amount of equity capital and other securities which a bank holds as reserves against risky assets. According to Basel II, CAR is measured using Tier 1 (Core Capital) and Tier 2 (Supplementary Capital). The sum of the Tier 1 Capital and Tier 2 Capital is divided by the Risk Weighted Assets (RWA) as shown in the equation below:

$$\text{Capital Adequacy Ratio (CAR)} = \frac{\text{Tier 1 Capital} + \text{Tier 2 Capital}}{\text{Risk Weighted Assets}} \quad (1)$$

where,

- Tier 1 Capital is the core capital and it can absorb a reasonable amount of loss without forcing the bank to stop its trading. It includes shareholders’ equity and retained earnings.
- Tier 2 Capital is the supplementary capital and it can sustain a loss if there is a liquidation. It includes subordinated loans, revaluation reserves, undisclosed reserves and general provisions.
- Risk Weighted Assets (RWA) are a key measure in risk management, and they are used to determine the minimum amount of capital that must be held by banks in order to reduce the risk of insolvency. Banks can increase their capital adequacy ratios by either increasing the amount of regulatory capital held, or by decreasing their RWA (Das & Amadou, 2012). RWA include credit risk, operational risk and market risk.

**Credit Risk:** This involves inability or unwillingness of a customer or counterparty to meet commitments in relation to lending, trading, hedging, settlement and other financial transactions (Spuchláková, Valasková, & Adamko, 2015).

**Operational Risk:** The risk of loss resulting from inadequate or failed internal processes, people, and systems or from external events (Federal Deposit Insurance Company, 2006).

**Market Risk** is the risk of loss resulting from changes in the prices of instruments such as bonds, share and currencies (Basel Committee on Banking Supervision, 2019).

The Central Bank of Botswana, Bank of Botswana (BOB), requires all banks in the country to maintain a capital adequacy ratio at or above 15 percent (Bank of Botswana, 2019). Majority of banks in Botswana are well capitalised, hence they have the ability to continue to honor their obligations.

The main objective of this paper is to analyse the determinants of CAR for nine banks in Botswana. The study covers the period 2015 to 2019. The study is divided into six sections, the Introduction in Section 1, followed by the Literature Review in Section 2, Definition of Variables in Section 3, The Modelling Approach is discussed in Section 4, Back Testing and Model Accuracy Test in Section 5, and finally section 6 will illustrate the Discussion of the Results and Conclusion.

## 2. Literature Review

El-Ansary and Hafez (2015) carried out a study to investigate the determinants of capital adequacy ratio on commercial banks in Egypt for the period 2003-2013 using multiple linear regression analysis. Some of their major findings were that, profitability had no impact on CAR, however, return on assets was found to be significantly positively correlated to CAR. Liquidity and management quality were found to be positively correlated to CAR while size of bank and risk was found to be negatively correlated to CAR. Asset quality was not correlated to CAR. Al-Tamini and Obeidat (2013) examined the factors that determine capital adequacy of commercial banks in Jordan for the period 2000-2008. Some of the major findings were that there was a statistically significant positive correlation between capital adequacy of commercial banks and liquidity risk, as well as rate of return on assets. Moreover, in their study they found out that there is an inverse relationship with statistical significance between capital adequacy and rate of return on equity and interest rate risk. In a study by Kartal (2019), the factors that influence CAR in the Turkish Banking Sector (TBS) for the period 2006/Q1 - 2019/Q1 were studied using Multivariate Adaptive Regression Splines (MARS) on 14 explanatory variables. It was found out that credits/total asset ratio, legal equities, risk weighted assets, non performing loans (NPL), NPL/total credits ratio and credit/deposits ratio were influential factors on CAR in Turkey.

Using panel data regression, Raharjo, Hakim, Manurung, and Maulana (2014) studied the determinants of capital ratio of the state-owned banks in Indonesia and it was established that the capital ratio was affected by the size of the bank, the bank's leverage, the quality of management, and the interest rate risk. Bhattarai (2020) carried out a study to determine the CAR of 11 commercial banks in Nepal for the period 2013/14 to 2017/18. The Pooled OLS, Fixed Effects Model and Random Effects Model were used for data analysis and it was established that liquidity, size of bank and inflation were the major determinants of CAR in Nepal with liquidity having a positive and statistically significant effect, whereas the size of the bank and inflation rate had negative and statistically significant results.

Soelton et al. (2019) studied the effect of CAR, operating expense, Net Interest Margin and Non Performing Loans on the Loan to Deposit ratio of conventional banks in Indonesia Stock Exchange. The study period was 2012-2017 and the analytical tool used was multiple linear regression analysis and one of the major findings was that CAR insignificantly negatively influences the Loan to Deposit ratio. Unvan (2020) investigated the effect of bank specific and macroeconomic factors on CAR of banks in Ghana for the period 2008-2017 using Generalized Method of Moments (GMM). It was established that bank size, leverage and broad money supply significantly influence the capital adequacy level of banks. Moreover, it was found out that bank profitability positively influences capital adequacy but at an insignificant level. Bateni, Vailifard, and Asghari (2014) examined the influence of seven financial factors on capital adequacy of Iranian banks for the period 2006-2012 and some of the major findings were that there is a positive relationship between Loan Asset Ratio, ROE, ROA, Equity Ratio and CAR.

El-Ansary, El-Masry, and Yousry (2019) carried out a comparative analysis of CAR determinants between 38 Islamic Banks (IBs) and 75 Conventional Banks (CBs) in MENA countries using GMM. CAR was used as the dependent variable and profitability, liquidity risk, credit risk, bank size, deposits to assets, operational efficiency, portfolio risk and two macro-economic variables as independent variables. In their study, it was found out that both Islamic banks and Conventional Banks have a significant association between CAR and bank size, operational efficiency and DP growth rate. A significant association between CAR and Deposits to Assets ratio was seen for IBs, while for CBs it was found out that there is an association between CAR and profitability, credit risk and portfolio risk. Alajmi and Alqasem (2015) studied the effects of seven internal factors on capital adequacy ratios of five conventional banks in Kuwait for the period 2005 to 2013 using fixed effect model and random effect model. When using the fixed effect model, it was found out

that size and ROA have a significant and negative relationship with CAR whereas the other five factors did not have any impact on CAR. When using the random effect model, it was found out that CAR was adversely affected by bank size and ROA was found to have a significant and positive relationship with CAR, whereas, LDR showed a significant and positive relationship with CAR. The other four factors did not have a significant effect on CAR.

Dreca (2013) examined the influence of eight factors on the CAR of 10 banks in Bosnia and Herzegovina for a study period of 6 years. Some of the major findings were that Size, Deposit to Total Asset ratio, Loans to Total Assets, Return on Assets, Return on Equity and Equity to Total Liabilities ratio had a significant effect on CAR while Loan Loss Provision to Total Loans ratio and Net Interest Income to Total Assets did not have a significant effect on CAR. Aktas, Acikalin, Bakin and Celi (2015) carried out a study to evaluate the impact of bank-dimensional and environmental factors on bank's capital adequacy ratio for 71 commercial banks that belong to 10 different countries in South Eastern European (SEE) region for the period 2007-2012. It was found out that under bank dimensional explanatory variables, the size, ROA, leverage, liquidity, net interest margin and risk have statistically significant effects in determining CAR, while under environmental factors, the economic growth rate, Eurozone Stock Market Volatility index, Deposit Insurance Coverage and Governance have statistically significant effect in determining CAR for banks in the region under study. Thoa and Anh (2017) examined the relationship between six internal banking factors (independent variables) and CAR (dependent variable) in the Vietnamese banking system. The study was carried out using linear regression analysis and the study period was 2011-2015. Some of the findings in the study were that, bank size and leverage have no impact on the CAR, while the net interest margin and liquidity have a significant positive impact on CAR.

### 3. Definition of Variables

When using multiple linear regression, the goal is to predict the dependent variable, which in this study is defined as:

- $Y = \text{CAR} = (\text{Tier 1 Capital} + \text{Tier 2 Capital}) / \text{Risk Weighted Assets}$

The independent variables  $X_i$  are:

- $X_1 = A.E = \text{Assets} / \text{Equity}$
- $X_2 = C.I = \text{Operating Expenses} / \text{Operating Income}$
- $X_3 = CA.TA = \text{Circulating Assets} / \text{Total Assets}$
- $X_4 = IE.A = \text{Interest Expense} / \text{Assets}$
- $X_5 = II.AVG.TA = \text{Interest Income on Loans} / \text{Average Total Assets}$
- $X_6 = II.IE = \text{Interest Income} / \text{Interest Expense}$
- $X_7 = \text{LDR} = \text{Loans} / \text{Deposits}$
- $X_8 = LLP.TL = \text{Loan Loss Provisions} / \text{Total Loans}$
- $X_9 = \text{NET.II.TI} = \text{Net Interest Income} / \text{Total Income}$
- $X_{10} = \text{NII.TI} = \text{Non-Interest Income} / \text{Total Income}$
- $X_{11} = \text{NIM} = \text{Net-Interest Income} / \text{Average Assets}$
- $X_{12} = \text{NPL.Ratio} = \text{Non Performing Loans} / \text{Gross Advances}$
- $X_{13} = \text{ROE} = \text{Net Profit after Taxes} / \text{Equity}$

### 4. The Modelling Approach

The study was based on 9 banks in Botswana and the data sources were their annual reports and financial statements. The 9 banks are; ABSA (formerly Barclays), Stanbic Bank Botswana, First National Bank Botswana, BancABC, State Bank of India, First Capital Bank, Bank Gaborone, Standard Chartered Bank Botswana and Bank of Baroda. The study period was 2015 to 2019.

4.1 Data Analysis

4.1.1 Descriptive Statistics

The descriptive statistics (mean, minimum, maximum, standard deviation, variance and skewness) for all the variables are shown in Table 1. The banks under study have an average CAR of about 20.81%, which is above the 15% required by the Bank of Botswana.

Table 1. Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance	Skewness	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
CAR	45	0.1520	0.4181	0.2081	0.0590	0.0035	2.1041	0.3537
A.E	45	3.4373	19.4935	9.9167	3.4276	11.7487	0.2539	0.3537
C.I	45	0.3176	2.1794	0.6866	0.3072	0.0944	3.1703	0.3537
CA_TA	45	0.0325	0.3839	0.1244	0.0875	0.0077	1.2127	0.3537
IE_A	45	0.0065	0.0695	0.0253	0.0128	0.0002	1.3810	0.3537
II_AVG_TA	45	0.0301	0.1004	0.0636	0.0154	0.0002	0.5198	0.3537
II_IE	45	1.4789	6.9847	3.1742	1.3342	1.7800	1.2594	0.3537
LDR	45	0.1624	1.0934	0.8302	0.1604	0.0257	-1.6114	0.3537
LLP_TL	45	-0.0033	0.0570	0.0115	0.0109	0.0001	1.8981	0.3537
NET_II_TI	45	0.4328	0.8124	0.6558	0.1041	0.0108	-0.2988	0.3537
NI_TI	45	0.1876	0.5672	0.3442	0.1041	0.0108	0.2988	0.3537
NIM	45	0.0190	0.0724	0.0434	0.0139	0.0002	0.4212	0.3537
NPL_RATIO	45	0.0000	0.0898	0.0434	0.0217	0.0005	-0.0675	0.3537
ROE	45	-0.2109	0.2512	0.1105	0.1049	0.0110	-0.9499	0.3537
Valid N (listwise)	45							

4.1.2 Multicollinearity Test

The dependent and independent variables are tested for multicollinearity using the correlation matrix shown in Table 2 and it was established that there was no significant correlation between CAR and the 13 independent variables.

Table 2. Correlation Analysis

	CAR	A.E	C.I	CA_TA	IE_A	II_AVG_TA	II_IE	LDR	LLP_TL	NET_II_TI	NI_TI	NIM	NPL_RATIO	ROE
CAR	1													
A.E	-0.6663	1												
C.I	0.2795	-0.0694	1											
CA_TA	-0.2004	-0.0662	-0.3049	1										
IE_A	0.0853	0.0446	0.2985	-0.1322	1									
II_AVG_TA	-0.4903	0.1906	-0.3406	0.1229	0.2304	1								
II_IE	-0.0803	-0.2814	-0.1618	0.0412	-0.6875	0.1106	1							
LDR	-0.3070	0.2507	-0.5886	-0.3686	-0.1010	0.3887	0.1914	1						
LLP_TL	-0.0239	0.0067	-0.4097	0.0830	-0.3409	-0.0445	0.2906	0.0783	1					
NET_II_TI	0.1799	-0.1563	0.0803	-0.0298	0.3134	0.3644	-0.1469	-0.2549	-0.0582	1				
NI_TI	-0.1799	0.1563	-0.0803	0.0298	-0.3134	-0.3644	0.1469	0.2549	0.0582	-1.0000	1			
NIM	0.0179	-0.3531	-0.1843	0.0074	-0.0326	0.4851	0.5836	0.3029	0.0420	0.2174	-0.2174	1		
NPL_RATIO	-0.4205	0.1829	-0.5701	0.3598	-0.2858	0.2700	0.1719	0.1182	0.5131	0.0708	-0.0708	-0.0967	1	
ROE	-0.4042	-0.0848	-0.5778	0.2990	-0.4183	0.4337	0.4904	0.4397	-0.1146	-0.2406	0.2406	0.3933	0.1961	1

4.2 Multiple Regression Analysis

The general CAR model is:

$$CAR = \beta_0 + \sum_i \beta_i * X_i + \mu \tag{2}$$

where;

- $i$  ranges from 1 to 13,
- $\beta_0$  is the constant term to be determined,
- $\beta_i$  are the coefficients to be determined,
- $X_i$  is the  $i^{th}$  driver of CAR,
- $\mu$  is a random error.

Table 3. Estimation of parametes for CAR Model

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
(Constant)	0.4379	0.0316		13.8591	0.0000	0.3740	0.5017		
A.E	-0.0115	0.0014	-0.6692	-8.0916	0.0000	-0.0144	-0.0086	0.9501	1.0525
1 ROE	-0.3155	0.0571	-0.5610	-5.5248	0.0000	-0.4309	-0.2001	0.6302	1.5869
NPL_RATIO	-0.9682	0.2756	-0.3557	-3.5127	0.0011	-1.5253	-0.4111	0.6339	1.5776
C.I	-0.0564	0.0231	-0.2939	-2.4419	0.0191	-0.1031	-0.0097	0.4485	2.2294

a. Dependent Variable: CAR

The CAR model is::

$$CAR = 0.4379 - 0.0115 * A.E - 0.3155 * ROE - 0.9682 * NPL\_RATIO - 0.0564 * C.I \tag{3}$$

From the CAR model and Table 3, it is evident that A.E, ROE, NPL\_RATIO and C.I are the most influential drivers of CAR for the banks under study. It was also established that A.E is the largest driver with a coefficient of -0.0115, therefore for every 1-unit increase in A.E, there is a 0.0115 decrease in CAR, assuming all other variables are held constant. Therefore, A.E and CAR are negatively correlated. The least influential driver with a coefficient of -0.9682 is NPL\_RATIO, meaning that for every 1-unit increase in NPL\_RATIO there is a 0.9682 decrease in CAR, assuming all other variables are held constant. Therefore, the NPL\_RATIO and CAR are negatively correlated. In the absence of all drivers, banks in Botswana generally have a CAR of 43.79% as derived from the constant of 0.4379 in the CAR model above.

The  $R^2$  and adjusted  $R^2$  values of 74.0% and 71.4%, respectively, shown in Table 4 indicate a good explanatory power for the regression model, as the  $R^2$  value shows that 74.0% of the variation in the dependent variable (CAR) is explained by the independent variables. The same applies for the adjusted  $R^2$  value, that is, 71.4% of the variation in the dependent variable (CAR) is explained by the independent variables.

Table 4. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.8600	0.7401	0.7141	0.0315

a. Predictors: (Constant), A.E, ROE, NPL\_RATIO, C.I

b. Dependent Variable: CAR

As shown in Table 5, the model has a significance value=0.000<0.05 (chosen significance level). This implies that the model is significant at the chosen level of significance of 5%. Therefore, A.E, ROE, NPL\_RATIO and C.I have a significant impact on the CAR of the 9 banks in this study.

Table 5. ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	0.1132	4	0.0283	28.4713	0.0000
1 Residual	0.0398	40	0.0010		
Total	0.1530	44			

a. Dependent Variable: CAR

b. Predictors: (Constant), A\_E, ROE, NPL\_RATIO, C\_I

### 5. Back Testing and Model Accuracy Test

#### 5.1 Back Testing

The model was back-tested using a data set compiled from 2015-2019 and the results in Table 6 were obtained. The model was able to predict the CAR for all the banks with an average error of 0.70%, 0.33%, 0.34%, -0.27% and -1.11% for 2015, 2016, 2017, 2018 and 2019, respectively. On average, for the study period, the model performed the best on 2018 data with an average error of -0.27% and performed the least on 2019 data with an average error of -1.11%. Using the 5 year average, the model was found to be most accurate when predicting the ABSA performance followed by Bank of Baroda, and the least accuracy was noted when predicting the CAR for BancABC.

Table 6. Back Testing

Bank Name	Actual CAR					Predicted CAR					Error					Average Error (5 Years)
	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019	
ABSA (formerly Barclays)	19%	20%	19%	18%	19%	20%	18%	20%	18%	18%	1%	-1%	1%	1%	-1%	-0.02%
Banc ABC	16%	20%	20%	18%	19%	19%	20%	24%	20%	21%	3%	0%	4%	2%	2%	2.22%
Bank Gaborone	18%	17%	18%	17%	16%	20%	16%	16%	16%	14%	2%	-2%	-2%	-1%	-2%	-0.80%
Bank of Baroda	23%	25%	22%	30%	27%	25%	25%	26%	29%	23%	2%	0%	4%	-1%	-4%	0.05%
First Capital Bank	17%	19%	16%	15%	20%	22%	16%	20%	14%	17%	5%	-3%	4%	-1%	-3%	0.51%
First National Bank	19%	16%	18%	18%	17%	19%	19%	18%	18%	18%	0%	3%	1%	0%	1%	0.98%
Stancbic Chartered Bank Botswana	24%	18%	19%	17%	18%	19%	18%	19%	17%	19%	-6%	0%	0%	0%	1%	-0.81%
Standard Chartered	20%	22%	16%	21%	19%	21%	19%	16%	18%	19%	2%	-3%	0%	-3%	0%	-1.05%
State Bank of India	33%	20%	42%	32%	39%	30%	29%	34%	33%	34%	-4%	9%	-8%	1%	-4%	-1.09%
Average Error (Yearly)											0.70%	0.33%	0.34%	-0.27%	-1.11%	

#### 5.2 Model Accuracy Test

The performance of the model in predicting the CAR of the banks under study was measured using the Mean Absolute Error (MAE), Mean Square Error (MSE) and Root Mean Square Error (RMSE). The model was found to perform well and the results are shown on Table 7.

Table 7. Model Accuracy Test

Model Accuracy Metrics	
MAE	2.19%
MSE	0.09%
RMSE	2.97%

### 6. Discussion of the Results and Conclusion

The research analyses the influence of thirteen financial ratios on the capital adequacy ratio of nine banks in Botswana. Asset to Equity Ratio (A\_E), Return on Equity (ROE), Non-Performing Loans Ratio (NPL\_RATIO) and Cost to Income Ratio (C\_I) were found to be the most influential drivers of the CAR in Botswana banks. The NPL ratio was found to be an influential driver of the CAR for the banks under study, which is in agreement with the study by Kartal (2019). The ROE, being one of the most influential drivers, is in agreement with Al-Tamini and Obeidat (2013), who found out that there is an inverse relationship between the capital adequacy and rate of return on equity. The A\_E Ratio was found to be the most influential driver of the CAR for the banks under study. For the study period, the model performed the best on 2018 data with an average error of -0.27% and performed the least on 2019 data with an average error of -1.11%. Using the 5 year average, the model was found to be most accurate when predicting the ABSA performance followed by Bank

of Baroda, and the least accuracy was noted when predicting the CAR for BancABC. The model was found to perform well with a MAE of 2.19%, a MSE of 0.09% and a RMSE of 2.97%.

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