

# Which profitability Measures Explain Better the Bank's Financial Soundness?

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**Abstract** The aim of this study is to examine the profitability measures that affect the bank's financial soundness, as measured by capital adequacy. Using a dataset of 2445 bank-year observations, results show that three profitability measures increase the variability of the capital adequacy ratios by 14.40%. Specifically, results show that return on assets, net interest margin and losses affect substantially bank's financial health. The results of this study are expected to aid bank executives, bank regulators and other stakeholders in evaluating better the bank's financial soundness.

**Keywords:** profitability, financial institutions, capital adequacy ratios, Basel Accord

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## 1. Introduction

Financial institutions in recent years have been facing higher risks of insolvency. The fact that banks are highly leveraged, it makes it even more difficult to survive if their reserves become inadequate to meet the debt holders needs. In an attempt to stabilize the financial sector and protect depositors, regulatory bodies worldwide, including the Bank of International Settlements (BIS), require that financial institutions maintain adequate capital, measured in the form of capital adequacy ratio (CAR), [1]. These ratios aim to promote stability and protect depositors of financial institutions [2,3,4,5].

Since capital adequacy is considered of paramount importance for the bank's financial soundness, researchers examined the determinants of the CARs, among those profitability, with inconclusive results. Mili, Sahut, and Trimeche [6], provided evidence that profitability and risk variables play an important role in explaining CARs, whereas other profitability ratios, including return on assets are not statistically significant in explaining CARs. In contrast to the above study, Aktas et al. [7] showed that return on assets, a measure of profitability, relates positively to CARs. In contrast to the above studies, Ahmad, Ariff, and Skully [8] provided evidence that the profitability measure net interest margin has a negative effect on CARs, a result inconsistent to expectations.

In an attempt to provide further evidence on the effect of profitability on CARs, we use all U.S. financial institutions included in the Federal Depository Insurance Corporation database. The present study complements and extends prior studies in the following respects: We test simultaneously several profitability measures. We also use a much larger and more recent dataset of financial

institutions. The data used in the present study were obtained from FDIC database and covered the period 2012 – 2017. The total number of firm year observations were 2,445. Multivariate statistical analysis results show that financial institutions with greater return on assets are expected to have higher capital adequacy, whereas banks with losses and higher net interest margins are expected to have lower capital adequacy. So firms that have losses are expected to contribute negatively towards bank's capital adequacy. The same applies for banks with very high net interest margins, meaning that these banks take much higher risk. Evidence shows that when the profitability measures are excluded from the model, the model's R-squared is 16.10% whereas when the three profitability variables are added in the model, the model's R-squared increases to 30.50%, which is an overall improvement of 14.10%.

The study proceeds as follows. Section two provides review of the literature. In section 3 we discuss data selection and the research design. Critical analysis of statistical results are presented in section 5 and the last section provides summary and conclusions.

## 2. Background and Motivation

Financial institutions play a very important role in the economy due to the fact that they have as deposits the savings of the entire economy. If financial institutions face financial distress problems, the whole economy will suffer since depositors will lose their savings and at the same time the governments have to step in and pay the deposit insurance [9,10]. Regulatory bodies worldwide, among those the Bank for International Settlements, through the Basel Accords, tried to impose some mechanisms, such as minimum capital requirements, namely the so called

capital adequacy ratios (CAR). CARs are used to promote the stability and efficiency of financial systems worldwide [11,12]. Also, CARs are used to protect stakeholders, and especially depositors, as a result of major risks faced by banks, especially, credit risk (from both balance sheet and off balance sheet exposures), operational risk, market risk and liquidity risk [1,3,4].

Since CARs relate to the bank's financial soundness, several researchers examined empirically the determinants of CARs, using various explanatory variables, among those, efficiency, riskiness, profitability and bank size. Evidence though on the relationship between profitability and CARs has been inconclusive.

Using multinational financial institutions, Mili et al. [6], showed that profitability and riskiness, as measured by net interest margin and loan loss provisions, respectively, are positively related to CARs. On the other hand, ROA, another profitability variable, was shown to be statistically insignificant. Consistent with the initial results of Mili et al [6], Bateni et. al. [13], Bokhari et. al. [14], Ho and Hsu [15], and showed that there exists a positive relationship between profitability and CARs. Also a study by Aktas et al. [7], who used a dataset of European banks during the crisis period provided evidence that profitability as measured by ROA relates to CARs. In contrast to the above results, the following researchers found negative, not positive relationship with CARs. Specifically, Ahmad, Ariff, and Skully [8] provided evidence that the profitability measure net interest margin is negatively related to CARs. These results are in contrast to prior studies possibly because banks with high interest margins undertake higher risk, and subsequently these banks have lower asset quality and thus higher non performing loans. In contrast to the aforementioned studies, Sivaraman, Krishnan and Sukar [16] who tested the determinants of CARs of U.S. CARs, provided evidence that bank profitability, riskiness and liquidity do not explain CARs. Consistent with Sivaraman et al [16], Shingjergji and Hyseni [17] showed that profitability is not statistically significant in explaining CARs.

Thus, as it can be seen from extant literature, the evidence regarding the relationship between profitability and CARs is mixed and inconclusive. Our study differs from prior studies in the following respects: We test simultaneously several profitability measures by using a much larger and more recent dataset of financial institutions.

The following hypothesis will be examined:

H1: There exists a positive relationship between various profitability measures and Capital Adequacy Ratios (CARs).

### 3. Methodology

#### 3.1. Collection of Data

The data used in this study were collected from FDIC (Federal Deposit Insurance Corporation) database. FDIC is a US federal agency that insures bank deposits in case a financial institution faces financial distress problems. Our final sample size consists of 2,445 bank year observations

from all US National Commercial banks in FDIC for the period 2012-2017. In order to be consistent with extant studies, we excluded from our sample observations with absolute studentized residuals greater than 2 since they were considered outliers.

#### 3.2. Multivariate Models

The following multivariate regression models will be used to examine the factors that affect the capital adequacy ratios of the US national financial institutions:

Reduced Model without profitability measures:

$$\begin{aligned} CAR_{Tier1} = & c_0 + c_4 * ch_{off_{prov}} + c_5 * ProvLoans \\ & + c_6 * ch_{off_{loans}} + c_7 * Loans_{dep} + c_8 * IntExp_{TA} \\ & + c_9 * ROE + c_{10} * LnTA + e. \end{aligned}$$

Full Model with all profitability measures:

$$\begin{aligned} CAR_{Tier1} = & c_0 + c_1 * ROA + c_2 * Nimy + c_3 * Loss \\ & + c_4 * ch_{off_{prov}} + c_5 * ProvLoans \\ & + c_6 * ch_{off_{loans}} + c_7 * Loans_{dep} + c_8 * IntExp_{TA} \\ & + c_9 * ROE + c_{10} * LnTA + e. \end{aligned}$$

The dependent variable is CAR\_Tier1: capital adequacy ratio-Tier1. Independent variables are: ROA: Return on assets, Nimy: net interest margin, Loss is an indicator variable that takes the value of 1 if the financial institution has losses during a specific year and 0 otherwise, charge\_off\_Prov is the credit loss provision to net charge off, Prov\_Loans: loss allowance to loans, Loans\_Dep: net loans and leases to deposits, IntExp\_TA is the interest expense to total assets, ROE is the return on equity, LnTA is the natural logarithm of total assets.  $c_0$  is the intercept term,  $c_i$ : slope coefficient,  $e_i$ : error term.

### 4. Empirical Results

#### 4.1. Descriptive Statistics

In Table 1 we show descriptive statistics for our variables that we included in our comprehensive multivariate regression model. Our results show that US banks have on average Tier 1 Capital adequacy ratios 15% (median 13.1%). The means of the three profitability ratios, Return on Assets (ROA), net interest margin (nimy) and loss are 1.2%, 4% and 3.4%, respectively. The means of the  $ch_{off_{prov}}$  and  $ch_{off_{loans}}$  are 0.271 and 0.474, respectively. Regarding  $Prov_{loans}$ ,  $Loans_{Dep}$ ,  $intExp_{TA}$  and ROE, their means are 1.535, 3,686, 0.5% and 9.4%, respectively.

#### 4.2. Correlation Analysis

Results in Table 2 show Pearson correlation analysis results between CARs, our independent variable, and all the independent variables. Evidence presented indicates that there is a relationship between Capital Adequacy Ratios (CAR\_Tier1) and profitability ratios and other explanatory variables. Results show that the return on

assets and net interest margin are positively related to capital adequacy whereas losses are negatively related. Specifically, the correlation between ROA and capital adequacy is 39.3% and the correlation between net interest margin and capital adequacy is 2.2%. Evidence also shows that *ch\_off\_prov*, provisions to loans and *ch\_off\_loans* variables are positively related to capital adequacy of financial institutions. Furthermore, results show that there is no multicollinearity between the explanatory variables since the the highest correlation among the these variables is only 63.4%. Detailed information about multicollinearity testing is presented later on in this study when the full regression analysis model is discussed.

### 4.3. Multivariate Analysis Results

#### 4.3.1. Reduced Model

In Table 3 we present results on the relationship between financial variables (excluding profitability) and capital adequacy (*CAR\_Tier1*), for all US banks from 2012 till 2017. Our final dataset includes 2,445 bank-year observations.

Regression model used:

$$\begin{aligned} CAR_{Tier1} = & c_0 + c_4 * ch_{off\_prov} + c_5 * ProvLoans \\ & + c_6 * ch_{off\_loans} + c_7 * Loans_{dep} + c_8 * IntExp_{TA} \\ & + c_9 * ROE + c_{10} * LnTA + e. \end{aligned}$$

**Table 1.**

	N	Mean	Median	Std. Deviation
CAR_Tier1	2445	0.150	0.131	0.065
ROA	2445	0.012	0.010	0.021
Nimy	2445	0.040	0.035	0.026
LOSS	2445	0.034	0.000	0.180
Ch_off_prov	2445	0.271	0.097	6.268
Prov_Loans	2445	1.535	1.227	1.259
Ch_off_Loans	2445	0.474	0.176	0.959
Loans_Dep	2445	3.686	0.846	72.051
IntExp_TA	2445	0.005	0.004	0.004
ROE	2445	0.094	0.085	0.128
LnTA	2445	15.069	14.911	1.893

Descriptive statistics results for all our U.S. banks included in our dataset for the period 2012-2017 are presented in this table. The dependent variable is *CAR\_Tier1*: capital adequacy ratio-Tier 1. Independent variables are: Return on assets, *Nimy*: net interest margin, *Loss* is an indicator variable that takes the value of 1 if the financial institution has losses during a specific year and 0 otherwise, *charge\_off\_Prov* is the credit loss provision to net charge off, *Prov\_Loans*: loss allowance to loans, *charge\_off\_loans*: net charge off to loans, *Loans\_Dep*: net loans and leases to deposits, *IntExp\_TA* is the interest expense to total assets, *ROE* is the return on equity, *LnTA* is the natural logarithm of total assets.

**Table 2. Correlation Analysis**

	CAR_Tier1	ROA	Nimy	LOSS	Ch_off_prov	Prov_Loans	Ch_off_Loans
CAR_Tier1	1.000	.393	.022	-.040	.035	.280	.110
ROA		1.000	.358	-.243	.019	.153	.160
Nimy			1.000	-.046	-.025	.437	.634
LOSS				1.000	.015	.179	.194
Ch_off_prov					1.000	-.029	-.014
Prov_Loans						1.000	.665
Ch_off_Loans							1.000
No of obs	2445	2445	2445	2445	2445	2445	2445

Pearson correlation analysis for all US banks for the period 2012-2017 are presented in this table. The dependent variable is *CAR\_Tier1*: capital adequacy ratio-Tier 1. Independent variables presented here are: *ROA*: Return on assets, *Nimy*: net interest margin, *Loss* is an indicator variable that takes the value of 1 if the financial institution has losses during a specific year and 0 otherwise, *charge\_off\_Prov* is the credit loss provision to net charge off, *charge\_off\_loans*: net charge off to loans, *Prov\_Loans*: loss allowance to loans.

**Table 3. Regression Analysis**

Variable	Coefficient	Std error	t-stat	significance
Ch_off_prov	.000	.000	2.359	.018
Prov_Loans	.017	.001	13.007	.000
Ch_off_Loans	-.007	.002	-4.017	.000
Loans_Dep	0.000	.000	-.233	.815
IntExp_TA	.011	.367	.029	.977
ROE	.098	.009	10.454	.000
LnTA	-.007	.001	-10.316	.000
Intercept	.219	.010	20.961	.000
F-value	67.800			.000
Rsquared	16.10%			
Number of Obs	2445			

Multivariate regression analysis results for all US banks for the period 2012-2017 are presented in this table. The dependent variable is *CAR\_Tier1*: capital adequacy ratio-Tier 1. Independent variables are: *charge\_off\_Prov* is the credit loss provision to net charge off, *Prov\_Loans*: loss allowance to loans, *charge\_off\_loans*: net charge off to loans, *Loans\_Dep*: net loans and leases to deposits, *IntExp\_TA* is the interest expense to total assets, *ROE* is the return on equity, *LnTA* is the natural logarithm of total assets.

Regarding overall results, the F-value of the model is 67.8, which is significant with a p-value 0.000. Results indicated that the explanatory variables affect CARs. Also, the adjusted R-squared is 16.1%, which implies that the model's explanatory variables explain 16.1% in the variability of the dependent variable CAR\_Tier1. Specifically, results indicate that five out of the six independent variables used in the model are statistically significant. These are Ch\_off\_loans, Prov\_loans, Ch\_off\_prof, ROE and LnTA.

#### 4.3.2. Reduced Model with Loss as the only Explanatory Variable

In Table 4 we present results on the relationship between capital adequacy (CAR\_Tier1) and only one profitability measure, namely loss, beyond financial variables for all US National financial institutions over the period 2012-2017.

Regression model used:

$$CAR_{Tier1} = c_0 + c_3 * Loss + c_4 * ch_{off\_prov} + c_5 * ProvLoans + c_6 * ch_{off\_loans} + c_7 * Loans_{dep} + c_8 * IntExp_{TA} + c_9 * ROE + c_{10} * LnTA + e.$$

**Table 4. Regression Analysis results with Loss variable only as profitability measure**

Variable	Coefficient	Std error	t-stat	significance
Loss	-.006	.008	-.715	.474
Ch_off_prov	.000	.000	2.373	.018
Prov_Loans	.017	.001	13.023	.000
Ch_off_Loans	-.007	.002	-3.894	.000
Loans_Dep	0.000	.000	-.227	.821
IntExp_TA	.026	.368	.071	.943
ROE	.094	.011	8.918	.000
LnTA	-.007	.001	-10.336	.000
Intercept	.220	.011	20.871	.000
F-value	59.370			.000
Rsquared	16.00%			
Number of Obs	2445			

Multivariate regression analysis results for all US banks for the period 2012-2017 are presented. The dependent variable is CAR\_Tier1: capital adequacy ratio-Tier 1. Independent variables are: Loss is an indicator variable that takes the value of 1 if the financial institution has losses during a specific year and 0 otherwise, charge\_off\_Prov is the credit loss provision to net charge off, Prov\_Loans: loss allowance to loans, charge\_off\_loans: net charge off to loans, Loans\_Dep: net loans and leases to deposits, IntExp\_TA is the interest expense to total assets, ROE is the return on equity, LnTA is the natural logarithm of total assets.

Regarding overall results, the F-value of the model is 59.37 and significant with a p-value 0.000. Results indicate that the explanatory variables used in the model affect CARs. Also, the adjusted R-squared of this model is 16.0% which means that the variables used in the model explain 16.0% in the variation of the Tier1 CARs. Specifically, results show that the profitability variable Loss does not affect the capital adequacy of financial institutions, beyond the other financial variables. Results also show that five out of the six explanatory variables used in the model are statistically significant, namely, Ch\_off\_loans, Prov\_loans, Ch\_off\_prof, ROE and LnTA.

#### 4.3.3. Reduced Model with Net interest Margin (nimy) as the Only Profitability Explanatory Variable

In Table 5 we present results on the relationship between capital adequacy (CAR\_Tier1) and only one profitability measure, namely net interest margin (nimy), beyond financial variables for all US National financial institutions.

Regression model used:

$$CAR_{Tier1} = c_0 + c_2 * Nimy + c_4 * ch_{off\_prov} + c_5 * ProvLoans + c_6 * ch_{off\_loans} + c_7 * Loans_{dep} + c_8 * IntExp_{TA} + c_9 * ROE + c_{10} * LnTA + e.$$

**Table 5. Regression Analysis results with Net interest margin (Nimy) only as profitability measure**

Variable	Coefficient	Std error	t-stat	significance
Nimy	-.765	.066	-11.570	.000
Ch_off_prov	.000	.000	2.202	.028
Prov_Loans	.017	.001	13.674	.000
Ch_off_Loans	.005	.002	2.350	.019
Loans_Dep	0.000	.000	.680	.497
IntExp_TA	.727	.363	2.004	.045
ROE	.154	.010	14.899	.000
LnTA	-.008	.001	-12.212	.000
Intercept	.251	.011	23.817	.000
F-value	79.290			.000
Rsquared	20.40%			
Number of Obs	2445			

In this table we present regression analysis results for all US financial institutions for the period 2012-2017. The dependent variable is CAR\_Tier1: capital adequacy ratio-Tier 1. Independent variables are: Nimy: net interest margin, charge\_off\_Prov is the credit loss provision to net charge off, Prov\_Loans: loss allowance to loans, charge\_off\_loans: net charge off to loans, Loans\_Dep: net loans and leases to deposits, IntExp\_TA is the interest expense to total assets, ROE is the return on equity, LnTA is the natural logarithm of total assets.

Regarding overall model results, the F-value of the model is 79.29 and statistically significant with a p-value 0.000. These results imply that the variables used in the model explain CARs. Moreover, the model's adjusted R-squared is 20.4%, which means that the variables used in the model explain 20.4% in the variation of the Tier1 CARs. Results show that the profitability variable net interest margin affects negatively the capital adequacy of financial institutions, beyond the other financial variables. Results also show that four out of the six explanatory variables, beyond the control variable LnTA, used in the model are statistically significant, namely, Ch\_off\_loans, Prov\_loans, Ch\_off\_prof, and ROE.

#### 4.3.4 Reduced Model with Return on Assets (ROA) as the Only Profitability Explanatory Variable

In Table 6 we present results on the relationship between capital adequacy (CAR\_Tier1) and only one profitability measure, namely ROA, beyond financial variables for all US National financial institutions.

Regression model used:

$$CAR_{Tier1} = c_0 + c_1 * ROA + c_4 * ch_{off\_prov} + c_5 * ProvLoans + c_6 * ch_{off\_loans} + c_7 * Loans_{dep} + c_8 * IntExp_{TA} + c_9 * ROE + c_{10} * LnTA + e.$$

**Table 6. Regression Analysis results with ROA only as profitability measure**

Variable	Coefficient	Std error	t-stat	significance
ROA	1.375	.076	18.011	.000
Ch_off_prov	.000	.000	1.858	.063
Prov_Loans	.014	.001	11.688	.000
Ch_off_Loans	-.010	.002	-5.668	.000
Loans_Dep	0.000	.000	-.479	.632
IntExp_TA	.093	.345	.268	.788
ROE	-.061	.012	-4.893	.000
LnTA	-.006	.001	-9.811	.000
Intercept	.212	.010	21.566	.000
F-value	107.900			.000
Rsquared	25.90%			
Number of Obs	2445			

In this table we present regression analysis results for all US financial institutions for the period 2012-2017. The dependent variable is CAR\_Tier1: capital adequacy ratio-Tier 1. Independent variables are: ROA: Return on assets, charge\_off\_Prov is the credit loss provision to net charge off, Prov\_Loans: loss allowance to loans, charge\_off\_loans: net charge off to loans, Loans\_Dep: net loans and leases to deposits, IntExp\_TA is the interest expense to total assets, ROE is the return on equity, LnTA is the natural logarithm of total assets.

Regarding the overall performance of the model, the F-value is 107.9 and statistically significant with a p-value 0.000. These results imply that the variables used in the model explain CARs. Also, the model's adjusted R-squared is 25.9%. Thus results indicate that the explanatory variables employed in the model explain 25.9% in the variability of the Tier1 CARs. Specifically, results show that the profitability variable ROA affects positively the capital adequacy of financial institutions, beyond the other financial variables. Results also show that five out of the six explanatory variables used in the model are statistically significant. These are Ch\_off\_loans, Prov\_loans, Ch\_off\_prof, ROE and LnTA.

#### 4.3.5. Full Model with All Profitability Measures as Explanatory Variable

In Table 7 we present results on the relationship between capital adequacy (CAR\_Tier1) and all three profitability measures, beyond financial variables for all US National financial institutions.

Regression model used:

$$\begin{aligned}
 CAR_{Tier1} = & c_0 + c_1 * ROA + c_2 * Nimy \\
 & + c_3 * Loss + c_4 * ch_{off\_prov} + c_5 * ProvLoans \\
 & + c_6 * ch_{off\_loans} + c_7 * Loans_{dep} + c_8 * IntExp_{TA} \\
 & + c_9 * ROE + c_{10} * LnTA + e.
 \end{aligned}$$

The F-value, which is an indicator of the overall performance of the model, is 108.5 and statistically significant with a p-value 0.000. These results imply that the variables used in the model explain CARs. Moreover, the model's adjusted R-squared is 30.5% which means that the variables used in the model explain 30.5% in the variation of the Tier1 CARs. Specifically, results show that all three profitability variables affect the capital adequacy of financial institutions, beyond the other financial variables. Results also show that five out of the six explanatory variables used in the model are

statistically significant. These are Ch\_off\_loans, Prov\_loans, Ch\_off\_prof, interest expense to total assets and LnTA.

**Table 7. Regression Analysis - Full Model with all profitability measures**

Variable	Coefficient	Std Error	t-value	Significance	VIF
ROA	1.398	.074	18.872	.000	2.082
Nimy	-.786	.062	-12.710	.000	2.246
LOSS	-.017	.007	-2.451	.014	1.360
Ch_off_prov	.000	.000	1.718	.086	1.003
Prov_Loans	.015	.001	12.476	.000	1.904
Ch_off_Loans	.003	.002	1.665	.096	2.806
Loans_Dep	0.000	.000	.537	.592	1.017
IntExp_TA	.878	.339	2.586	.010	1.194
ROE	-.017	.014	-1.256	.209	2.607
LnTA	-.007	.001	-12.087	.000	1.087
Intercept	.248	.010	24.917	.000	
F-value	108.500			.000	
Rsquared	30.50%				
Number of Obs	2445				

In this table we present regression analysis results for all US financial institutions for the period 2012-2017. The dependent variable is CAR\_Tier1: capital adequacy ratio-Tier 1. Independent variables are: ROA: Return on assets, Nimy: net interest margin, Loss is an indicator variable that takes the value of 1 if the financial institution has losses during a specific year and 0 otherwise, charge\_off\_Prov is the credit loss provision to net charge off, Prov\_Loans: loss allowance to loans, charge\_off\_loans: net charge off to loans, Loans\_Dep: net loans and leases to deposits, IntExp\_TA is the interest expense to total assets, ROE is the return on equity, LnTA is the natural logarithm of total assets.

Finally, evidence presented in this table shows that the maximum value of the Variance Inflation Factors (VIFs) is 2.806, thus there is no multicollinearity. Econometric analysis states that multicollinearity will be a problem if VIFs are greater than 10.

In summary, based on the aforementioned discussion, evidence shows that profitability measures do affect bank's capital adequacy.

## 5. Summary & Conclusions

In this study we examined whether profitability measures play an important role in explaining capital adequacy indicators of US banks. Our sample includes 2455 banks from 2012 till 2017. Our results indicated that financial institutions with greater return on assets are expected to have higher capital adequacy, whereas banks with losses and higher net interest margins are expected to have lower capital adequacy. So firms that have losses are expected to contribute negatively towards bank's capital adequacy. The same applies for banks with very high net interest margins, meaning that these banks take much higher risk. Evidence shows that when the profitability measures are excluded from the model, the model's R-squared is 16.10% whereas when the three profitability variables are added in the model, the model's R-squared increases to 30.50%, which is an overall improvement of 14.10%. Evidence also shows that the biggest improvement is due to the inclusion of the ROA in the model. Specifically, when this variable was added in the

model, the R-squared increased from 16.10% to 25.90%, an overall increase of 9.80%.

To sum up, the present evidence has practical implications and it should be of interest to bank executives and major stakeholders for decision making purposes and to regulators for policy purposes.

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