

Credit risk management and its impact on the profitability of Algerian banks: An applied study using Panel –Data model during the period 2009-2020

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Abstract

This study aims to investigate the relationship between credit risk management and the profitability of commercial banks by testing the impact of credit risk indicators on assessing the profitability of a sample of Algerian commercial banks during the period 2009-2020 by using a panel-data model. The results of the applied study indicate that: the ratio of loan loss provisions to total loans and capital adequacy ratio are the most important indicators of credit risk management that affect and contribute to evaluating the profitability of Algerian commercial banks.

1. Introduction

The role of banks as financial intermediaries is crucial in financing economic growth by borrowing from savers and lending to companies that need resources for investment. The success of this role depends primarily on their efficiency and performance. Bank lending is a key function, it determines future profitability and reflects the banks' performance; banks recently have become more aware of customer selection to avoid the negative effects of poor and non-performing loans. Credit risk management is becoming increasingly important as an effective tool in assessing banks' performance and profitability, owing to the extent of losses that banks can bear as a result of the non-performing loan problem, where credit risk is a serious problem facing banks in their business. It can freeze an important portion of bank funds because of the inability of borrowing customers to pay their premiums and interests in due time. This may attenuate their profits. This study aims to emphasize the importance of credit risk management and its role in supporting actions and measures to improve the profitability and performance of banks. It also attempts to link the effect of credit risk indicators with profitability indicators in Algerian commercial banks by analyzing how credit risk management indicators help assess Algerian commercial banks' performance and identify factors affecting profitability the most.

1.1. The study objectives

Accordingly, the study seeks to achieve the following objectives:

- To clarify the importance of credit risk management on banks' performance.
- To examine the relationship between credit risk management and the profitability of Algerian banks.
- To determine the indicators and measures that illustrate the relationship between Algerian banks' profitability and credit risk management.

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1.2- Problem of the study:

This research paper attempts to answer the following question:

How do credit risk management indicators influence the assessment of Algerian commercial banks profitability during the period 2009-2020?

1.3- The hypothesis of the study

To answer this question, the following hypotheses have been formulated:

Hypothesis 1: Increasing the ratio (loans loss allocations / total loans) accrues the level of non-performing loans along with the risk of credit, which has a negative impact on the profitability and performance of banks.

Hypothesis 2: Increasing capital adequacy reduces the level of non-performing loans and credit risk. That positively reflects on the profitability and performance of banks.

Hypothesis 3: The high ratio (total loans / total deposits) increases the level of non-performing loans besides the risk of credit. That negatively affects the profitability and performance of banks.

1.4- Study methodology and tools used

To achieve the objectives of the study, to address the problem, to analyze the results, as well as to test the validity of hypotheses, the study relied on the descriptive approach to describe and analyze aspects of the topic, drawing the theoretical aspect of the most important studies, theses and scientific articles on the subject. In practice, the study relied on a case study method by examining the case of a sample of Algerian commercial banks, using data collected from the sample banks' reports during the period 2009-2022. Using Panel-data model with some statistical programs include spss 22, evIEWS 9, and EXCEL version 2007.

2. The theoretical framework:

Credit risk has a great impact on banks' safety. The extent of the credit risk relies on the quality of assets held by banks. The types and quality of assets refer to a specific risk exposure. Aburime (2008) asserts that a bank's profitability is primarily based on its potential to foresee, keep away from, reveal risks, and cover losses by loans losses allocations. Hence, in decision making of resources allocation of assets distribution, a bank should consider the degree of risk to the assets (Olweny & Shiphoo, 2011, p. 5). Loans are the largest investment component of assets and the largest source of income for banks. If a loan defaults, the ability of banks to make new loans will be constrained, interest income on those loans will drop, and banks will have to put loan loss provisions in place, ultimately reducing their profitability. The credit risk or credit quality of a bank is expressed as non-performing loans (NPLs). Therefore, non-performing loans can be adopted to measure a bank's ability to deal with the risk of defaulting on debtor repayments (Buchory, 2015, p. 58).

Declining asset quality and low liquidity are also reasons for bank failures, as poor asset quality caused many banks to default after the last banking crisis. According to Waweru and Kalani (2009), many of the financial institutions that failed in 1986 were due to non-performing loans (NPLs). However, Koch (1995) argues that a good measure of credit risk or asset quality is the ratio (loan loss reserve / total loan) because it translates management's expectations of loan performance. Hempel et al (1994) observed that banks with high loan growth generally took more risk because of less stringent credit analysis and review procedures, but the rate of return on such loans was high, suggesting a trade-off between risk and return (Olweny & Shiphoo, 2011, p. 5).

Credit risk management is a key function of financial institutions (especially banks). The main activity of commercial banks is lending, which exposes loans to risk of non-repayment. Nonperforming loans can lead to a bank failure and jeopardize the financial system's stability. Bernanke (2003) said that, in the Great Depression of 1930, customers defaulted on loans taken from banks; the rise in non-performing loans reduced banks' profit margins, and was predicted that profitability would be negatively correlated with NPLs. Miller and Noulas (1997) studied the credit risk position in American banks in 1980, concluding that the banks' performance was weak by their low-quality loan portfolios. The study revealed the severe impact of loan loss allocations on bank profitability in 1980 (Ahiabor, 2013, p. 16). Athanasoglou et al (2005) study, found that credit risk is an important factor of Greece banks profitability. Similar result was reported by Garza-Garcia (2012) for Mexican banks; however, the results were not strong across the models employed in the first study (Athanasoglou & all, 2005, pp. 22-25).

3. Review of research literature:

Many researchers have studied the extent of the impact of credit risk on banks' financial performance, we try to summarise a set of such studies as follow:

Nawaz & Munir (2012), evaluates the effect of credit risk on Nigerian banks profitability. Bank performance and credit risk are measured using financial ratios. Data are derived from a sample of bank annual reports and accounts from 2004 to 2008. The ratio of non-performing loans to total loans and the ratio of total loans to total deposits are used as credit risk indicators, while return on assets (ROA) is a performance indicator. The analysis used the correlation coefficient and the multiple regression model. The results show that credit risk management has a significant effect on the profitability of Nigerian banks.

The study of Musyoki & Kadubo (2012) aimed to assess the various variables of credit risk management that affect banks' financial performance. These variables were: default rate (non-performing loans to total loans) ratio, (bad debt expenses to total costs) ratio and (operating costs to total loans) ratio. For seven years (2000-2006), financial records from ten banks were used to examine profitability ratios, comparing the profitability ratio (return on assets) with the default ratio, the cost of bad debt, and the cost of loans. The data was analyzed using a regression model and a correlation coefficient. The findings showed that while all of these variables have an inverse relationship with bank financial performance, the default rate is the best predictor of bank financial performance when compared to other credit risk management indicators.

Kolapo & all (2012) investigated the impact of credit risk on commercial bank performance in Nigeria throughout the period (2000-2010). On the basis of eleven years of cross-sectional data, five commercial banks were chosen. The return on assets (ROA) is a profitability measure. As measures of credit risk management, three ratios are used (total non-performing loans to total loans), (total loans to total deposits), and (loan loss provisions to loans classified). To assess profitability determinants, the fixed effect of Panel model was used. According to the results, the increase in non-performing loans impacted profitability.

Also, Onaolapo & Olufemi (2012) examined the effects of capital adequacy on financial performance of selected banks within the Nigerian banking sector. The data used for a ten-year period from 1999 to 2008. The results of the model indicated that the parameters examined inclusive of Efficiency Ratios, Return on Capital Employed and Returns on Assets had no impact on Capital Adequacy Ratio (CAR).

The study of Kaya & Pastory (2013) aims to research the relationship between credit risk and the bank's performance of a sample of 11 banks in Tanzania during the period 2005-2011. Credit risk is measured by: The ratio of loans losses to gross loans, the ratio of loans losses to net loans and the ratio of non-performing loans to total loans. The association between credit risk indicators and bank performance (measured by return on assets) was investigated using a regression model. The results demonstrated that credit risk indicators caused a negative relationship through high credit risk, and low bank performance.

While Ogboi & Unuafe (2013) used time series and cross sectional data from 2004 to 2009 to investigate the effect of credit risk and capital adequacy on bank financial performance in Nigeria. The influence of loan loss provisions, loans and advances, non-performing loans and capital adequacy on return on asset was also estimated using a panel data model. According to their results, credit risk management and capital adequacy ratio have a positive effect on bank profitability, but loans and advances have a negative effect on financial performance.

Samuel (2014) searched the impact of credit risk on the top five Nigerian commercial banks' performance from 2008 to 2012. Non-performing loan, loans and Advances ratios is employed as a credit risk indicator and return on assets as a profitability indicator. Using a simple regression model, the results revealed that the ratio of loans and advances to total deposits is negatively; but not significantly, related to profitability. and that the ratio of non-performing loans to total loans is correlated with a significant negative relationship to profitability.

Muthaher & M.Si (2014) examined the effect of Risk Financing (non-performing loans) and Capital Adequacy Ratio (CAR) to Profitability of Islamic banks in Indonesia. The financial ratios of Islamic banks are calculated from the statistical report of the Islamic Banks published by Bank of Indonesia from 2009 to 2012. The results of multiple linear regression showed that CAR had a positive relationship, and a significant impact on return on asset; the non-performing loans ratio is negatively correlated with return on assets and is not significant. The test results indicate that $R^2 = 0.121$ shows the explanatory power of two independent variables at 12.1% of the return on assets; Profitability is affected by 87.9 % due to other indicators not included in the regression model.

Abiola & Olausi (2014) examined the impact of credit risk management on banking sector performance in Nigeria for a sample of 7 banks from 2005 to 2011. The data was analyzed using the fixed effect panel model. The results showed that non-performing loans ratio and capital adequacy ratio is significantly correlated with the banks performance indicators (Return on Equity and Return on Asset).

Kayode & all (2015) studied the effect of credit risk on Nigerian commercial banks' performance. A panel analysis of six banks during the (2000- 2013) period. Credit risk measured by non-performing loans to total loans ratio and loans-loss provisions to total loans ratio have a negative and statistically significant effect to bank performance (return on assets). This shows that a higher credit risk exposure affects bank profitability. As for credit risk measured by total loans to total assets ratio, that has a positive and statistically significant effect on the bank's performance.

Kutum (2017) investigated the influence of credit risk on the profitability of 5 banks listed on the Palestine Securities Exchange during the period 2010-2015. Return on equity and return on assets were used to determine profitability, while net charge-offs to total loans and advances, non-performing loans to total loans and advances, and pre-provision profit to total loans and advances were used to determine credit risk. Other variables such as bank size, leverage, and net income growth were added. Using the regression model, credit risk (non-performing loans to total loans and advances) and profitability (return on assets) had a weak positive correlation. The study also discovered that bank size has a positive effect on profitability.

Poudel (2018) examined the basic indicators of credit risk in Nepalese commercial banks from 2002 to 2014, involving 15 commercial banks. The data was analyzed using the Fixed Effect Model. The findings indicated that credit risk has a negative and a significant influence on commercial banks profitability in Nepal. Furthermore, profitability is negatively impacted by the solvency ratio, interest spread rate, and inflation, but there is no statistically significant relationship. Capital adequacy ratio, total assets, and GDP growth have a positive and significant effect on commercial banks profitability in Nepal. Finally, the study found a positive statistically insignificant relationship between the interbank interest rate, and profitability.

There has been a discussion and controversy about the impact of credit risk management on the financial performance of banks. Extensive studies were carried out on this subject, and led to different results concerning the impact of credit risk on the performance and profitability of banks. Some studies confirmed the existence of a negative correlation between credit risk and bank profitability, while others showed a positive relationship. Other studies found that there was no relationship between them, such as Onalapo & Olufemi (2012). Others pointed out other factors different from the effects of credit risk management.

4. Methods and Materials:

4.1. Population and Sample of Study: The study population consists of Algerian banks, which numbered 20 public and foreign banks. Eight banks were selected as a sample for the study, which included three public banks: (Algerian National Bank BNA, Algerian External Bank BEA, Algerian People's Loan CPA) and five foreign private banks: (Arab Banking Corporation ABC, Societe Generale Bank SGA, BNP Algerians, Trust Bank of Algeria TRUST and Gulf Bank of Algeria AGB). The data were collected from the banks' annual reports, in addition to the data of the BankScope and Data Stream database. The study period covered 12 years, from 2009 to 2020.

4.2. Study variables:

- The dependent variable: is represented by the profitability indicator, which is: the rate of return on assets (ROA).
- Independent variables: are represented by credit risk measure indicators, which are: the ratio of loan loss provisions to total loans CR1; Capital adequacy ratio CR2 and the ratio of total loans to total deposits CR3 which used as a controlling variable.

In order to build the model, we have identified the study variables, using the most important previous studies to select these variables, Table 1. summarizes the study variables.

Table 1. Variables used to study the impact of credit risk indicators on profitability indicators

variable	Explanation	Expected effect	Studies and research
Ratio of loan loss provisions to total loans CR1	An indicator that measures management's outlook for future loan losses. A rough indicator of the quality of a portfolio is also considered to compensate for the risk of default in the loan portfolio.	(-)	(Ogboi & Unuafe, 2013) ; (Kaya & Pastory, 2013) ; (Kayode & all, 2015); (Kutum, 2017)
the capital adequacy ratio CR2	Measures the ability of the banking sector to absorb any risk losses or some macroeconomic imbalances. The high percentage indicates high profitability and the lower proportion causes the lower profitability.	(+)	(Onaolapo & Olufemi, 2012); (Ogboi & Unuafe, 2013) ; (Muthaher & M.Si, 2014); (Abiola & Olausi, 2014); (Poudel, 2018)
the ratio of total loans to total deposits CR3	This ratio measures bank liquidity and the bank's ability to make loans from deposits collected.	(-)	(Kolapo & all, 2012); (Nawaz & Munir, 2012); (Ogboi & Unuafe, 2013); (Samuel, 2014)

Source: prepared by the researchers

4.3- Panel data model

The correlation between credit risk management and profitability of Algerian commercial banks is investigated using a panel data analysis approach. A panel data set is a longitudinal or cross-sectional set of economic entities that are tracked over time. In this study we use a balanced panel data model of nine banks covered 12 years, from 2009 to 2020. The model used is:

$$ROA_{it} = \beta_0 + \beta_1 CR1_{it} + \beta_2 CR2_{it} + \beta_3 CR3_{it} + \varepsilon_{it}$$

ROA_{it} = Profitability of bank i at time t .

$CR1_{it}$ = Ratio of loans loss provisions to total loans of bank i at time t .

$CR2_{it}$ = Capital adequacy ratio of bank i at time t .

$CR3_{it}$ = Ratio of total loans to total deposits of bank i at time t .

ε_{it} = The error term.

5. Results and Discussion

5.1- Empirical Results:

To test the problem of multicollinearity, we set up the correlation matrix on the Pearson test, and, according to Gujarati, there is a problem of strong linearity. If the correlation coefficient between two independent variables is 0.8 or higher, there is a correlation between them (Gujarati, 2004, p. 359). Table No. (02) indicates that the correlation values between the variables used in the study, and the correlation matrix has revealed that there is no problem of linear duplication between the explained variables because each of them did not exceed 0.80. All variables can be used in the model, and the findings show a link between credit risk indicators and profitability indicators (return on assets), where we find the following:

- A positive statistically significant correlation exists between the CR2 indicator and the ROA variable, where the correlation coefficient obtained between the two variables is estimated to be 0.632.

- There is a positive statistically significant relationship between CR3 and ROA, where the correlation coefficient obtained is estimated at 0.439.

Table 2. Correlation Matrix

		Corrélations			
		ROA	CR1	CR2	CR3
ROA	Pearson correlation	1	,035	,632**	,439**
	Sig. (two-tailed)		,736	,000	,000
	N	96	96	96	96
CR1	Pearson correlation	,035	1	,159	-,003
	Sig. (two-tailed)	,736		,122	,980
	N	96	96	96	96
CR2	Pearson correlation	,632**	,159	1	,777**
	Sig. (two-tailed)	,000	,122		,000
	N	96	96	96	96
CR3	Pearson correlation	,439**	-,003	,777**	1
	Sig. (two-tailed)	,000	,980	,000	
	N	96	96	96	96

** . The correlation is significant at the 0.01 level (two-tailed).

Source: Prepared by the researchers based on spss 22

To estimate the impact of credit risk indicators on bank profitability, we use three longitudinal data models and to perform the tests, we need to choose the correspondent model among the three models. With the help of Eviews 9 program, we estimate the parameters of the three models and the results are shown in Table (03).

Table 3. Results of estimating panel models using the ROA indicator

Variables	the Pooled Regression Model.	the fixed individual effects model	the random individual effects model.
C	0.016397(*)	0.006374	0.011607(*)
CR1	-0.064423	-0.159781(*)	-0.114332
CR2	0.067544(*)	0.067039(*)	0.061462(*)
CR3	-0.007995	0.003555	-0.001360
R²	0.413698(*)	0.576021(*)	0.282296(*)

parameter significance at 0.05

Source: Prepared by the researchers based on Eviews 9

For comparison, we use the Redundant Fixed effects Tests, and through Table (04) we note that the probability of testing is less than 0.05 and that the calculated F value is estimated at 4.648996 which is greater than the *tabulated values*: $F_{tab}(0.05, 07, 85) = 2.11929643$. This means rejecting the null hypothesis and accepting the hypothesis that there are fixed individual effects, i.e., the best model is the fixed individual effects model compared to the Pooled Regression Model.

Table 4. Redundant Fixed Effects Test Results Using the ROA Indicator

Redundant Fixed Effects Tests
Equation: EQ02
Test cross-section fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	4.648996	(7,85)	0.0002
Cross-section Chi-square	31.118663	7	0.0001

Source: Prepared by the researchers based on Eviews 9

To do this, we test the Breusch-Pagan test. This test gives the results shown in Table (05), where we note that the probability of Breusch-Pagan testing is less than 0.05, which means rejecting the null hypothesis and accepting the hypothesis of the existence of random individual effects. Which is the best model compared to Pooled Regression Model.

Table 5. Breusch-Pagan test results using the ROA Indicator

Lagrange Multiplier Tests for Random Effects
Null hypotheses: No effects
Alternative hypotheses: Two-sided (Breusch-Pagan) and one-sided (all others) alternatives

	Test Hypothesis		
	Cross-section	Time	Both
Breusch-Pagan	12.81892 (0.0003)	2.144945 (0.1430)	14.96386 (0.0001)

Source: Prepared by the researchers based on Eviews 9

- a) Hausman test for the comparison between the random effects model and the fixed effects model: to compare between the two models (the random-effects model and the fixed-effects model), the Hausman test gives the results obtained in Table No. (06). Note that the calculated χ^2 value is ($\chi^2=8.339545$) and it is greater than the *tabulated values* ($\chi^2=7.81472776$) and the significant is less than 0.05, so we reject the null hypothesis and say that the appropriate model is the fixed effects model.

Table 6. Results of the Hausman test using the ROA Indicator

Correlated Random Effects - Hausman Test
Equation: EQ03
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	8.339545	3	0.0395

Source: Prepared by the researchers based on Eviews 9

- b) Wald test: We use a Wald test to ascertain the fixed effect of each bank is not null. The test results shown in Table (07) indicate that F Value Calculated is (258.7731) at degrees of freedom 4 and 85 at the significance level 05 percent greater than the tabulated value: F (2.47901547). The calculated value of χ^2 is ($\chi^2=1035.092$) at the level of statistical significance 0.05 and the degree of freedom 4 is greater than the tabulated ($\chi^2=9.48772904$), as a result, the null hypothesis is rejected, and we adopt the alternative hypothesis that the parameters are not zero, which confirms the validity of previous tests, including the appropriate model which is the fixed effect model.

Table 7. Wald's Test Results Using ROA Indicator

Wald Test:
Equation: EQ02

Test Statistic	Value	df	Probability
F-statistic	258.7731	(4, 85)	0.0000
Chi-square	1035.092	4	0.0000

Source: Prepared by the researchers based on Eviews 9

5.2. Credit Risk Indicators and Bank Profitability Relationship:

The analysis of the results of fixed effect model revealed that two variables were selected for the credit risk management indicators with a statistical significance that has an impact on the performance and profitability of Algerian commercial banks, in explaining the trend of the dependent variable (ROA): the ratio of loan loss provisions to total loans (CR1) and Capital adequacy ratio (CR2). These independent variables contribute to the explanation of 57.60% changes in the dependent variable (ROA). The inverse relationship between the ratio of loan loss provisions to total loans CR1, and the dependent variable ROA explains that a higher value of loan loss provisions translates into a growth in size of no-performing loans, which leads to an increase in credit risk. This will reflect negatively on the profitability and performance of banks. Accordingly, **hypothesis 1 is accepted**. This result is consistent with the findings of (Kolapo & all, 2012), (Musyoki & Kadubo, 2012), (Kaya & Pastory, 2013) and the study of (Kayode & all, 2015).

The positive and significant correlation between CR2 and the dependent variable ROA, explains that the high capital adequacy ratio translates into a decrease in the volume of no-performing loans; thus, a decrease in credit risk which reflects positively on the profitability and performance of banks; and thus, **hypothesis 2 is accepted**. These results are in accordance with the study of (Ogboi & Unuafe, 2013) and the study of (Muthafer & M.Si, 2014). However, they contradict the study of (Onaolapo & Olufemi, 2012), which concluded that there is no relationship of the capital adequacy ratio to the return on assets and the study of (Abiola & Olausi, 2014) which concluded that there is a positive relationship without statistical indication.

The analysis also revealed a negative relationship without statistical significance between the ratio of total loans to total deposits and the dependent variable, which indicates that CR3 does not affect or explain the dependent variable. So **hypothesis 3 is rejected**. This result is consistent with the findings of (Samuel, 2014), (Nawaz & Munir, 2012) and (Ogboi & Unuafe, 2013) Studies, and contradicts the study of (Kolapo & all, 2012) that arrived at a positive relationship. Table No. (08) summarizes the results of hypotheses testing.

Table 8. Results of hypothesis testing for the ROA model

Hypothesis	code	Expected effect	results obtained	decision
Hypothesis 1	CR1	(-)	(-) (*)	accepted
Hypothesis 2	CR2	(+)	(+) (*)	accepted
Hypothesis 3	CR3	(-)	(-)	rejected

(*) : parameter significance at 0.05 **Source:** prepared by the researchers

6. Conclusion

The study examined the effect of credit risk management on the profitability of a sample of Algerian commercial banks during the period 2009-2020, using a fixed Panel data model. Among the economic theories, the focus was on the determination of most important indicators that reflect credit risks, and through the applied study, we accessed the following results:

- The analysis of the results of the fixed effect model shows the selection of two variables: the ratio of loan losses provisions and the capital adequacy ratio as explanatory variables for commercial banks' profitability.
- The ratio of loan losses provisions and the capital adequacy ratio are the main variables in determining the quality of the Bank's assets.
- Variable CR3 (ratio of total loans to total deposits) does not affect the profitability of Algerian commercial banks.

Finally, the study recommends that Algerian banks devise and implement solutions that would not only reduce their exposure to credit risk but also enhance their profitability and competitiveness through three main policies:

- Diversification of banking products;
- Increasing banking competition by adopting Islamic banking formulations; and
- Extending policy by setting up international subsidiaries.

Based on the study, other indicators not studied in this research have a 42.40% contribution to the assessment of the profitability of Algerian commercial banks and therefore require further research to manage credit risks to improve the profitability and performance of Algerian banks.

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