



The Impact of Liquidity, Credit, Financial Leverage Risks on Financial Performance of Islamic Banks: The Case of Sudanese Banking Sector

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Abstract

This study empirically investigates the impact of liquidity and credit risks plus financial leverage on the financial performance of Islam banks in Sudan during the period from 2008 to 2018. The study uses panel dataset of (143) observations from (13) Islamic banks. Two models of ROA and NPM have been constructed using robust random effects (GLS) estimates for testing the study hypotheses. The independent variables consist of credit risk that measured by non-performance of loans (financing) and provision of loans (financing) loss ratios; and the liquidity risk is measured by three ratios that include cash to total deposits, liquid assets to total assets and total loans (financing) to total deposits; plus, the financial leverage ratio. The financial performance of Islamic banks in Sudan is measured by the ratios of return on assets and net profit margin. The results reveal that the credit risk and financial leverage have a significant and negative impact on the financial performance of Islamic banks in Sudan, whereas the liquidity risk generally found to be insignificant. However, the liquidity risk in term of liquid assets to total assets ratio provides a significant and positive influence on the financial performance of Sudanese banks. The importance of this study is that it touches the most significant financial risks that Sudanese Islamic banks face during their operational and long-term cycles. Moreover, the study can provide insights to policy and decision makers in banking sector in Sudan toward managing aforementioned risks.

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1. Introduction

1.1. Background

Islamic finance has gained a significant attention at the global arena during recent decades, and especially after its resistance to recent global crisis. Now a days, it is not surprising that Islamic financing system is seen as an alternative to conventional financing system through statistics that underscore a rapid growth of Islamic financial assets and institutions that prohibit dealing with interest rates. Moreover, Islamic finance potentially serves both a growing 1.7 billion Muslim populations around the globe and increasingly interested non-Muslim customers. The Islamic finance assets grew by 6% from 2012 to 2017 to reach US\$ 2.44 trillion, and expectation of further growth to US\$3.8 trillion by 2023. It is worth mentioning that Islamic banks share an approximately of 70% to 72% out of Islamic finance assets during 2017 and 2018 (Thomson, 2018). Furthermore, Islamic banking is seen to be a systemically important in 12 jurisdictions that account for 92% of the global Islamic banking assets, with the largest ones are Iran, Saudi Arabia, United Arab Emirates, Malaysia, Kuwait and Qatar (Islamic Financial Services Board – IFSB, 2018).

Like other countries, the banking sector in Sudan expected to play a significant role in promoting various commercial and non-commercial sectors and to create a development in the economy. The emerging of Islamic banking in Sudan began in mid-1980s when formally Faisal Islamic bank started its operations in the country. Subsequently, the Islamic finance industry passed through different stages till it reach to a full-fledged Islamic financial system by 1992. Despite of the noticeable growth in Islamic banks in Sudan, they

still considered relatively young comparing with their peers in other Muslims' jurisdictions. This mainly due to low intermediation, the narrow of equity and foreign exchange markets, and the financial markets and institutions that are still in developing stage (Burger, 2018).

As know, in Islamic economy the banking sector is the dominant financial business that provide financing facilities and participate in economic projects. However, the activities that run by Islamic banking give rise to various types of risks. These risks include common types of risks that similar to what expose to conventional banking industry, such as liquidity, credit, operational, market risks. Additional types of risks that are uniquely associated with Islamic banking industry are equity investment, rate of return and Shariah non-compliance risks. Therefore, Islamic banks are fundamentally required to establish an effective framework for managing the aforementioned risks, to diversify the sources of funds generation and financing projects, and to apply soundness measurements and controls for each types of risks.

Given the nature of Islamic banking activities, this study tends to investigate the impact of credit risk, liquidity risk and financial leverage on Islamic banks in Sudan. The Islamic banks in Sudan are heavily investing in non-participatory modes of finance (such as Murabaha, Ijarah, Istisna, Salam) rather than Profit-loss-Sharing modes of finance, as severally reported by central banks of Sudan. This trend is obviously exposing the banks in Sudan to credit and liquidity risks. Moreover, the supervisory body directives the banks to increase their equity capital in order to enhance the banks' capability to absorb any potential risk and to partially protect the depositors' rights.

1.2. Statement of Problem

The nature of banking industry – as a business of risks – provides a valid reason to articulate the statement of problem of this study as: “the lack of managing the risks by Islamic banks shall potentially affect their financial performance in unfavourable way”. Consequently, the negative impact extends to banks' owners, management, funds' depositors and other stakeholders. Therefore, understanding, measuring and controlling risks are paramount important in banking industry in order to achieve its objectives.

1.3. The Objectives and Scope of the Study

The main objectives of this study include assessing the impact of various types of risk (mainly liquidity, credit and financial leverage risks) on the financial performance of Sudanese banks, and to shed a light on key risks and financial performance measures in Islamic banks that can assist both decision and policy makers in such industry. Additionally, the study aims to contribute to the concerned empirical literature in the field of risk management and financial performance of Islamic finance industry.

The study is structured as follows: Section two provides a brief literature that focuses on liquidity, credit and financial leverage risk, and the impact of risk management on banks' financial performance. Section three demonstrates the applied methodology that include study dataset, approach, hypotheses, variables characteristics, and model specification. Section four explains the empirical results and discussion of the findings. Finally, section five provides a conclusion, recommendations and limitations of the study.

2. Literature Review

Looking into the Islamic banking industry; there are many studies tackled the relationship between risks and bank's financial performance and the impact of such risks on the financial performance of Islamic banks.

In study of a sample of 60 Islamic banks in MENA and South-eastern Asian countries, Ben and Hamza (2015) assessed the liquidity risk determinants during the period of 2004 – 2012. The study found that liquidity risk that measured by two ratios of loan to assets and cash to total assets have a positive and significant relationship with banks' rerun of assets (ROA). This result matched the findings of Chowdhury, Zaman, and Alam (2019) when the profitability measured by return of assets and rerun on equity (ROE) in their study of six Islamic Banks in Bangladesh during the period of 2012 to 2016. Furthermore, Islam and Amir (2016) argued that liquidity risk in Islamic banks has a negative and significant impact to their financial performance; regardless these banks are in a surplus or shortage of liquidity. It has been justified that the more liquidity risk exposure leads to enforce the banks to depend highly on internal source of funds (Alzoubi, 2017). Therefore, Islamic banks need to balance their assets and liabilities and to strength their policies and strategies to manage normal liquidity requirement in order to prevent liquidity distress. From other hand, Ahmed and Khan (2007); Ariffin, Archer, and Karim (2009); Akhtar, Ali, and Sadaqat (2011) and Islam, Farooq, and Ahmad (2017); Incekara and Çetinkaya (2019) stated that Islamic banks are riskier toward liquidity position than conventional banks, and it impose a challenge to the management in the context of trading-off between liquidity risk and bank's performance. Contrary, Iqbal (2012); and Gafrej and Abbes (2017) argued that the liquidity position in Islamic banks is better than conventional banks and they have strong cushion against the balance sheet's shocks. In all cases, Muharam (2013) and Effendi and Disman (2017) stated that liquidity risk factors in Islamic and conventional banks are the same, and the differences come from the banks' contractual system, structure of investments portfolio and profitability approach.

For a large number of world's largest deposit-taking banks, Bace (2016) studied the relationship of liquidity and credit risks to banks' profitability during the period of 2014-2015. The linear regression model

resulted that the credit risk metrics of; nonperforming loan ratio has a negative and significant impact on return of assets (ROA), while the equity to assets ratio found to be a positive and significant relation. Additionally, the liquidity risk as measured by loan/advances to deposits ratio has slightly negative relation with banks' profitability. The study observed that liquidity risk and banks' equity capital have significant implications on banks' performance.

Al Rahahleh., Bhatti, and Misman (2019) reviewed the developments of risk management in Islamic banks in Malaysia. The author's study showed that the expansion of loan financing, quality of the loans, and sufficient capital are the major determinants of credit risk in Islamic banks. Consequently, these determinants of credit risk have an impact on banks' performance. The study suggested that any deterioration in financing quality creates a nonperforming loan situation, which in return forces Islamic banks to allocate more loss provisions. Accordingly, the more nonperforming loan and increasing of loan loss provision lead to an increase of credit risk that have a negative effect on bank's profitability.

Furthermore, Alshatti (2015) examined the effect of credit risk management on financial performance of the Jordanian banks. His study covered a period from 2005 to 2013 for a sample of 13 banks. The banks' financial performance was measured by the ratios of ROA and ROE while the credit risk was measured by the nonperforming loan to total loan, provision of loan loss to loan and the leverage ratios. The study results revealed that the credit risk indicators of nonperforming and provision of loan loss have a significant effect on financial performance of the Jordanian banks. The nonperforming loan showed a positive relationship with banks' financial performance while the provision of loan loss provided a negative impact. Therefore, banks need to manage their credit risk by deeply rely on the diversification of credit risk to decrease the nonperforming amount which will motivate to reduce the amount of provision of loan loss and the to improve the quality of loan and bank's profitability (Ahmadyan, 2018). Additionally, Misman and Bhatti (2020) examined the critical issues that are related to credit risk in a sample of 72 Islamic banks from nine countries from South East Asian Nations (ASEAN) and Gulf Cooperation Council (GCC) regions during the period of 2000-2011. The results indicated that quality of loan (financing) has a significant positive effect on credit risk. Also, the large-size Islamic banks have the capacity to lower its credit risk in a comparison with the small-size peers, especially when these banks have access to more equity's capital.

Sarwar (2018) explained that financial leverage ratio along with asset turnover and earning per share as independent variables have a positive relation to ROA. This result provided when the author investigated the core issues of profitability and market size of Islamic banking in Pakistan. The study was based on a sample size of 10 banks during a period from 2007 to 2016. Also, the influence of bank's financial leverage or gearing on bank's ROA has been identified by Khalil and Khalil (2017) as insignificant while it has a positive influence on the ROE of Islamic banks in Pakistan from 2007 to 2015. Moreover, due to the expansion of Islamic banking, a comparative study conducted by Issa (2020) to compare the riskiness between Islamic and conventional banks during the 2008 global crisis. The author measured the overleveraging by the difference between actual and optimal debt by using a sample of 10 conventional and 10 Islamic banks from five countries. The study argued that excess debt can serve as an early indicator of crises and collapse of banks. additionally, the study provided an evidence that Islamic banks has the capacity to manage their debt better than conventional banks prior the financial crises of 2008, however, they were impacted by the second phase of the crisis that begin in 2011. The Islamic banks in the GCC countries have been examined by Menacer, Saif-Alyousfi, and Ahmad (2019) to see whether the financial leverage has an impact on financial performance. The study covered the period from 2005-2017 and its data gathered from 25 listed Islamic banks. The findings revealed that the financial leverage has a positive and significant impact on financial performance indicators of the Islamic banks in the GCC countries; which measured by ROA, ROE, and Tobin's Q.

In a comparative study between Islamic and conventional banks, Tafri, Hamid, Meera, and Omar (2009) examined the impact of financial risks on bank's profitability. The study covered a period of 10 years (1996 – 2005). Profitability of banks measured by ROA and ROE, while the financial risks include credit risk that measured by provision of loan loss to total asset, interest rate risk, liquidity risks that measured by liquid assets to total liabilities and bank's equity to total assets ratio. The results from panel data regressions revealed that credit risk has a negative and significant impact on both ROA and ROE, while the liquidity risk found to be insignificant on banks' profitability. In addition to that, the study showed that the impact of interest rate risk is significant on ROA only for the conventional banks and it has no impact on Islamic banks' profitability. Regarding the bank capitalization, the study concluded to the significant of bank's capital with a positive sign to the profitability of Islamic banks.

Also, Al-Rdaydeh, Matar, and Alghzwai (2017) used a sample of 13 conventional banks and three 3 Islamic banks for a period from 2005 to 2015 to investigate the influence of financial risks on the profitability of Jordanian banks. The study employed panel data regression for testing the study hypotheses. The study indicated that credit risks (in term of loan loss provision) and liquidity risk (in term of loan to deposits ratio) have negative and significant influence on ROA of both types of banks.

Additionally, Amaliah and Hassan (2019) analysed the relationship between credit risk, liquidity, and capital adequacy with Indonesian banks during the period of 2007-2016. The results found that there is a negative and significant impact of nonperforming loan ratio on banks' return of assets and net profit margin,

while the liquidity risk (that measured by financing loans to deposits ratio) has a negative and significant impact on ROA only. The capital adequacy is shown to be insignificant toward banks' profitability.

A further study conducted by [Abbas, S., and Aziz \(2019\)](#) on a sample of the 174 banks from 10 countries from Asian countries plus USA to explore the influence of bank capital, liquidity risk, and credit risk on the bank's profitability (that measured by ROA and ROE ratios). The study covered the postcrisis period between from 2011 to 2017. The study results revealed that credit risk when it measured by loan loss provision ratio has a negative and significant influence on the profitability of banks that have large and medium sizes, while the impact is insignificant for in smaller banks. The findings also indicated that liquidity risk (in term of liquid assets to total assets ratio) has a significant impact on banks' profitability with a positive sign in Asian banks, whereas it has negative impact in case of USA banks. the study claimed that large banks have ability to use their liquid assets in more diversified manners.

Regarding risks management in Sudanese Islamic banks, [Ahmed \(2016\)](#) studied the Sudanese banks during 2002 to 2014 toward the interrelationship between the nonperforming loans (finances) and credit risk management. The study results showed that the framework of credit risk management in the Sudanese banks is sufficient and it wasn't a cause of an increase in the nonperforming loans (finances) level. However, the adverse macroeconomic conditions that associated with various economic sectors in Sudan justified the increase of nonperforming loans (finances) as a credit risk issue. Moreover, [Elgadi \(2016\)](#) conducted an empirical study using a panel data estimation models to assess the performance of Islamic banking industry in Sudan during the period from 2005 until 2013. The profitability ratios of return on assets (ROA) and return on equity (ROE) are used to measure the banks' performance. The main results indicated that ROA has a significant and adverse relationship with operation efficiency, credit risk, leverage ratio and profit-loss-sharing mode of financing. Additionally, the results revealed the factors of bank age, size, capitalization and liquidity on banks' profitability.

Another study in the context of credit risk of Sudanese banks is conducted by [Mustafa \(2019\)](#). The study examined the impact of credit risk on the financial performance of Islamic banks in Sudan during the period from 1995 to 2017. The results found that the credit risk is adversely affecting the banks' ROA, and the banks are deeply depending on collateral to mitigate the credit risk. With respect to liquidity risk management in Sudanese Islamic banks, [Mustafa \(2020\)](#) used panel data analysis to investigate its impact on the financial performance during 1992 to 2018. The liquidity risk measured by three ratios as liquid assets to total assets, total loan (financing) to total deposits, and current deposits to total deposits, while the banks' financial performance is measured by ROA ratio. The findings of the study suggested that current deposits to total deposits, total loan (financing) to total deposits ratios have a negative impact on banks' ROA, whereas liquid assets to total assets ratio provides a significant and positive sign.

Moreover, [Mennawi. and Ahmed \(2020\)](#) found that credit risk has a positive relationship with liquidity risk in Sudanese Islamic banks. Also, their study indicated that banks in Sudan maintain high level of cash buffer and liquid assets for the purpose of meeting the depositors' withdrawals as most of the deposits are in current and saving accounts. Finally, [Abdo and Onour \(2020\)](#) applied a panel data technique in a sample of 25 Sudanese banks in order to examine the liquidity risk determinants for during the period of 2012-2016. The findings of the study indicated that the investment, and profitability are positively significant to liquidity risk; whereas the budget deficit variable is insignificant to liquidity risk. The study argued that Sudanese Islamic banks are rely on short-term securities (sukuk) as significant proportion in their investment portfolios as a result of the absence of risk-hedging tools.

3. The Study Methodology

3.1. Data, Sampling and Study Approach

The study uses panel data of 11 years (from 2008 to 2018) and a sample of (13) Islamic banks in Sudan. The sample is randomly selected from a pollution of 37 full-fledged Islamic banks. For the purpose of this study, a secondary data has been collected from the audited annual financial statements to construct (6) independent variables that represent liquidity, credit and financial leverage risks on the (2) dependent variables that measure the Islamic banks' financial performance in Sudan. The study follows the longitudinal research design with the type of balanced panel data estimate and a quantitative approach. It is worthening to mention that panel data analysis has the advantages of increasing the precision in the estimation when the researcher investigate the relationship between variables, it provide the researcher more informative data and it improves the efficiency of econometric estimates, and it allows controlling for individual heterogeneity that shall reduce risk of obtaining biased results [Cameron and Trivedi \(2005\)](#); and [\(Brooks, 2008\)](#). Moreover, STATA.16 software has been used to analyse the data and models.

Following null hypotheses (H1 to H6) have been established and tested with confidence level of 95% ($\alpha = 0.05$):

H.1: The liquidity risk in form of CADP ratio has a positive and significant impact on financial performance Sudanese banks.

H.2: The liquidity risk in form of LQTA ratio has a positive and significant impact on financial performance Sudanese banks.

H.3: The liquidity risk in form of FIDP ratio has a positive and significant impact on financial performance Sudanese banks.

H.4: The credit risk in form of NPL ratio has a negative and significant impact on financial performance Sudanese banks.

H.5: The credit risk in form of LLP ratio has a negative and significant impact on financial performance Sudanese banks.

H.6: The financial leverage ratio has a negative and significant impact on financial performance Sudanese banks.

3.2. Variables Characteristics and Model Specification

3.2.1. Dependent Variables

Financial Performance: The financial performance of Sudanese banks is measured by the ratios of return on assets (ROA) and net profit margin (NPM). The literature provides an evidence that ROA is widely used to assess the degree of bank's financial performance throughout profitability status. The ROA explains the bank's profitability and how management is efficient in utilizing bank's resources to generate profitability. Such ratio is extensively used as a measurement of banks' financial performance in many studies such as in Ben and Hamza (2015); Alshatti (2015); Bace (2016); Elgadi (2016); Al-Rdaydeh et al. (2017); Sarwar (2018); Amaliah and Hassan (2019); Menacer et al. (2019); Abbas et al. (2019). Furthermore, the NPM has chosen in this study as a measure to assess the efficiency of bank's operational results. Such ratio has been used by Amaliah and Hassan (2019).

The study calculated the financial performance indicators as follows:

ROA = Net Profit (after tax) / Total Assets %

NPM = Net Profit (after tax) / Total Revenue %

3.2.2. Independent Variables

Liquidity Risk: Liquidity risk indicates an unfavourable financial position that results from either shortfall or excess in liquidity position. Banks carefully need to manage such risk in order to meet both planned and unplanned liquidity withdrawal, and to provide necessary level of funds to finance the targeted investment opportunities. Accordingly, this study selected three metrics to measure the magnitude of liquidity risk with reference to previous studies. These measures are.

1) Cash Ratio (CADP) = Cash and Cash Equivalent / Total Deposits %

This ratio expresses the proportion of total deposits that can be immediately settled to or withdrawals by depositors from available cash and cash equivalent at bank. The higher the ratio the lower the risk of shortage in cash. The ratio can represent the liquidity buffer for meeting the regular withdrawals and operations.

2) Liquid Assets Ratio (LQTA) = Liquid Assets / Total Assets %

Such ratio indicates the percentage of liquid assets out of total bank's assets. The liquid assets generally include the cash and cash equivalent, reserves at central bank, and short-term marketable securities (such as sukuk). The more liquid assets at bank provides a caution for the liquidity risk. In contrary, the maintaining high level of liquid assets jeopardize the long-term investments decision that it may affect the bank's profitability.

3) Use of Deposits in Financing (FIDP) = Total Financing (Loans) / Total Deposits %

The ratio of FIDP represents the portion that acquired funds from depositors that uses to finance Islamic bank's investments and customers. The high percentage of FIDP ratio indicates that the depositors' funds are largely invested by the bank, therefore, the bank expects to have inadequate liquidity funds to meet depositors' withdrawals, especially if the maturity matching not managed well. From other hands, the bank's profitability is expected to be high in case of large portion of deposits' funds being used to generate earnings, considering that the cost of deposits is relatively low.

Credit risk: The literature shows that non-performing loan (NPL) and provision of loan loss provision (LLP) ratios are the most widely ratios that use to measure the credit risk management and quality of loan in the bank. Since Islamic banks are not dealing with interest rate, the term of financing replaces the term of loan. The NPL is a percentage of gross loans (financing) that represents the doubtful or impairment proportion from investment portfolio of banks. Given that, the management of bank establishes a LLP to absorb the NPL and any potential loss from a doubtful of collection from the bank's counterparty. The more NPL and LLP, the higher credit risks. The calculation of NPL and LLP in Islamic banks as follows:

1) Nonperforming Loan (NPL) = Nonperforming loan (financing) / Gross Loan (Financing)

2) Loan Loss Provision (LLP) = Loan (Financing) Loss Provision / Gross Loan (Financing)

Financial Leverage: Financial leverage expresses the relationship between bank's debts and equity funds. Basically, the existing of debts' funds in banks' financial position constitute a core financing source. Nevertheless, a high leverage ratio creates higher business risk for a bank which in turn makes it more difficult to acquire further external capital and tends to increase cost of borrowing from external parties. The simplest way to calculate the bank's financial leverage is by dividing the total debts over total equity. For Islamic banks, the equation is the same as in conventional banks since the investment account holders generally take the characteristics of debts. Therefore, the calculation of financial leverage ratio in this study as follows:

$$\text{Financial Leverage Ratio} = \text{Total Debt} / \text{Total Shareholders' Equity}$$

Following Table 1 provides summary for the variables that used in this study.

Table-1. Variables of the study.

Type of Variable	Variable Name	Variable Description	Symbol	Expected sign
Dependent Variable	Financial Performance	Return on Asset	ROA	
		Return on Equity	ROE	
Independent	Liquidity Risk	Cash to Total Deposits	CADP	Positive
Independent		Liquid Assets to Total Assets	LQTA	Positive
Independent		Total Financing to Total Deposits	FIDP	Positive
Independent	Credit Risk	Nonperforming Loan	NPL	Negative
Independent		Loan Loss Provision	LLP	Negative
Independent	Financial Leverage	Debt to Equity Ratio	DTEQ	Negative

The models can econometrically be presented as follows:

Model 1: $ROA = \beta_0 + \beta_1 CADP_{it} + \beta_2 LQTA_{it} + \beta_3 FIDP_{it} + \beta_4 NPL_{it} + \beta_5 LLP_{it} + \beta_6 DTEQ_{it} + \varepsilon_i \dots(1)$

Model 2: $NPM = \beta_0 + \beta_1 CADP_{it} + \beta_2 LQTA_{it} + \beta_3 FIDP_{it} + \beta_4 NPL_{it} + \beta_5 LLP_{it} + \beta_6 DTEQ_{it} + \varepsilon_i \dots(2)$

Where:

β_0 : The intercept.

$\beta_1 - \beta_6$: The regression coefficients of independent variables.

i & t : they refer to the banks and the period in the study, respectively.

ε_i : the prediction error (residual).

The study follows panel data analysis in order to research its empirical findings. Data and variables screening process include the descriptive statistics, multicollinearity test, detection of stationarity of time series data through testing of unit root, and cointegration test. Additionally, testing of heteroskedasticity and serial correlation (autocorrelation) of the models' residuals are applied to assure the consistency and efficiency of the regression estimates. The tests of Hausman and Breusch/Pagan LM are used to guide for selecting the most appropriate regression models.

4. Empirical Result and Discussion

4.1. Descriptive Statistics

Table 2 shows the descriptive statistics that provide general highlights into the characteristics of a studied sample. The standard deviation of each variable does not exceed its respected mean except for the variable NPL that indicates a variation between the sampled banks. Also, the table provides statistics that implies a large variation between the minimum and maximum for most of the variables since the composition of the sample includes different sizes of banks.

Table-2. Descriptive Statistics.

Variable	Mean	Std. Deviation	Minimum	Maximum
ROA	3.085874	2.883725	-7.02	14.06
NPM	33.06294	19.86734	-49.18	68.17
CADP	34.46846	16.39138	6.53	96.98
LQTA	40.31769	15.96231	10.31	95.38
FIDP	64.04531	21.81467	2.85	138.57
NPL	5.934755	3.977206	.9	22.38
LLP	4.232727	4.481716	.23	26.37
DTEQ	679.5806	438.616	9.56	2464

4.2. Multicollinearity

Multicollinearity occurs when an independent variable is highly correlated with one or more independent variables which decrease the ability to predict the dependent measure (Hair, Black, & Anderson, 2014). Common means for detecting multicollinearity are to calculate the correlation coefficients between any two of the explanatory variables, and the Variance Inflation Factor (VIF) with its corresponding tolerance of the effect that the other independent variables have on the standard error of a regression coefficient. Multicollinearity will not be an issue in case that the correlation coefficients are lower than 0.80 and VIF not exceed 10 (tolerance values of 0.1). Accordingly, following Table 3 shows that the largest pairwise correlation coefficient is 0.5805 between LQTA and FIDP. Additionally, the diagnostics test indicates that there is no inflation in the variances of the parameters' estimates as the VIF values lie between 1.08 and 3.38 (0.2960 <

tolerance < 0.926) which is lower than the suggested thresholds by Hair et al. (2014) (VIF value ≤ 5 with a tolerance value ≥ .20). Therefore, we conclude that there is no multicollinearity problem between the independent variables.

Table-3. Multicollinearity tests of independent variables.

	Pairwise Correlation Coefficient						Variances Inflation Factor	
	CADP	LQTA	FIDP	NPL	LLP	DTEQ	VIF	Tolerance
CADP	1.0000						1.99	0.5036
LQTA	0.4942	1.0000					3.38	0.2961
FIDP	-0.1461	-0.5805	1.0000				1.64	0.6099
NPL	0.2011	-0.0246	0.0264	1.0000			1.31	0.7654
LLP	-0.1729	0.4455	0.2067	0.4134	1.0000		2.15	0.4653
DTEQ	-0.2512	-0.1528	0.0455	0.1273	0.0113	1.0000	1.08	0.9259

4.3. Unit Root Tests

The presence of a unit root in any time series means that the mean and variance are not independent of time. Therefore, traditional regression techniques based on non-stationary time series produce a spurious regression. As the literature suggests that panel-based unit root tests have higher power than unit root test based on individual time series. We applied Levin, Lin, and Chu (2002) and Im, Pesaran, and Shin (2003) for the stationarity test. Table 4 shows that the series are either stationary at level, I(0) or at first differencing, I(1). Accordingly, we tested the data series for cointegration.

Table-4. The results of unit root tests.

Variable	Levin, Lin & Chu			Im, Pesaran and Shin		
	Statistic	Prob.	Result	Statistic	Prob.	Result
ROA	-4.61880	0.0000	I (0)	-2.56040	0.0001	I (1)
NPM	-2.07606	0.0189	I (0)	-2.90913	0.0022	I (1)
CADP	-7.64655	0.0000	I (1)	-1.80467	0.0356	I (1)
LQTA	-1.86038	0.0314	I (0)	-1.62218	0.0396	I (1)
FIDP	-9.05443	0.0220	I (1)	-2.64137	0.0041	I (1)
NPL	-7.93642	0.0000	I (0)	-3.43167	0.0003	I (1)
LLP	-2.49807	0.0062	I (0)	-3.09556	0.0001	I (1)
DTEQ	-6.84509	0.0000	I (0)	-2.02626	0.0214	I (0)

4.4. Cointegration Tests

The study used Kao (1999) and Pedroni (1995) tests are most widely used for testing the cointegration. As per Table 5, the Modified Phillips-Perron (PP) and Augmented Dickey-Fuller (ADF) provide p-values less than 0.05 for the two models. This result evidences to reject the null hypothesis of no cointegration between the variables, at 0.05 level of significance.

Therefore, we can conclude that there will be a long run relationship between the explanatory variables and dependent variable in the two models of the study.

Table-5. The results of cointegration tests.

Model	Model 1 (ROA)		Model 2 (NPM)	
Pedroni Test for cointegration				
Test	Statistics	P-value	Statistics	P-value
Modified Phillips-Perron t	6.9478	0.0000	6.7410	0.0000
Phillips-Perron t	-4.1524	0.0000	-6.0044	0.0000
Augmented Dickey-Fuller t	-71.1857	0.0000	-98.9131	0.0000
Kao Tests for cointegration				
Test	Statistics	P-value	Statistics	P-value
Augmented Dickey-Fuller t	3.6411	0.0001	2.3074	0.0105
Modified Dickey-Fuller t	-5.1840	0.0000	-4.3774	0.0000
Dickey-Fuller t	-5.1532	0.0000	-3.7962	0.0001

4.5. Residual Diagnostics

4.5.1. Heteroskedasticity

Heteroskedasticity appears when the errors do not have a constant variance. Despite that still there are consistent estimates of the regression coefficients, but these estimates will not be efficient and they will be biased. In such case robust standard errors should be computed for correcting of possible presence of heteroskedasticity (Baltagi, 2005); (Brooks, 2008).

Following [Table 6](#) shows the results of Breusch-Pagan test for heteroskedasticity. The results show that probability of Chi square is less than 0.05 for both models, which reject the null hypothesis of homoskedasticity at 0.05 (significance) level. Therefore, we conclude that heteroskedasticity is exist in the two models of this study.

Table-6. The result of heteroskedasticity test.

Model	Chi 2	Prob.
ROA	35.12	0.0000
NPM	7.63	0.0057

Therefore, an alternative approach to deal with the heteroskedasticity issue in panel data estimates is by clustering the standard error estimates ([Brooks, 2014](#)) in order to make the regression efficient and consistent.

4.5.2. Autocorrelation (Serial Correlation)

The study carried out Durbin-Watson (D-W) test and Breusch-Godfrey test for identifying if there is autocorrelation between explanatory variables of the models. The D-W test deals with first order autocorrelation of the residuals U_t and U_{t-1} , whereas Breusch-Godfrey test extends for testing the residuals up to U_{t-r} , which makes it a general test ([Brooks, 2008](#)). Following [Table 7](#) shows the results from D-W and Breusch-Godfrey LM tests for autocorrelation.

Table-7. The results of autocorrelation tests.

Test	Breusch-Godfrey		Durbin-Watson
	Chi ²	Prob.	D-W statistics
ROA	0.052	0.8190	1.960002
NPM	2.343	0.1258	1.75175

The results of Breusch-Godfrey test show that the p-values of Chi squares are larger enough than 0.05 at (significance) level. Additionally, D-W statistics results are 1.96 and 1.75 for models ROA and NPM respectively. Hence the tests concluded that there is no serial correlation in the models' residuals.

4.6. Model Determination and Regression Analysis

The study follows ([Park, 2011](#)) guidelines of model selection. Formal test of Hausman is carried out to examine whether correlation between an individual effect or/and time effect and regressors is exist or not. The results revealed that the error term is non correlated with any of the regressors in both models of ROA and NPM since the p-value is larger enough than 0.05 level of significance. By this, Random Effects Model (REM) produces valid results than Fixed effects Model (FEM). Furthermore, we used Breusch and Pagan LM test to assess the choice between REM and Pooled OLS. The large Chi squared provides p-values less than 0.05 at (significance) level. By this we can reject the null hypothesis that individual specific or random specific error variance components are zero. Thus, the REM is appropriate than Pooled OLS model. Following [Table 8](#) shows the results from Hausman test and Breusch and Pagan LM test

Table-8. Results of model determination tests.

Test	Hausman Test		Breusch and Pagan LM	
	Chi ²	Prob.	Chi ²	Prob.
ROA	5.87	0.4378	164.04	0.0000
NPM	4.31	0.6346	60.14	0.0000

Finally, the study uses random effects model with the option of robust for models ROA and NPM to control for heteroskedasticity.

Furthermore, [Table 9](#) presents the parameters of goodness of fit of the ROA and NPM econometrics models. The values of R² (coefficient of determination) for the model ROA is 0.63, whereas for model NPM is 0.60 which provide explanatory power of the models. the joint variations in the explanatory variables of risk management measures 63.7% of the variation in ROA and 60.4% variation in NPM, while the remaining percentages refer to the variation due to other factors. The chi squared statistics with their significance p-values indicate the goodness of fit for the joint effect of all variables in the models. σ_e refers to the standard error of estimates, while rho represents the ratio of individual-specific error variance to the composite error variance in the models. The individual specific error account for 67.4% and 49.7% of the entire composite errors in ROA and NPM models, respectively.

Table-9. Model fitness parameters.

Model	R ²	Wald chi2	Prob.	sigma_e (SEE)	rho
ROA	0.6372	169.10	0.0000	1.3019481	0.67463701
NPM	0.6045	144.28	0.0000	11.16938	0.49766096

4.7. Discussion of the Results

For testing the study hypotheses, the regression coefficients the two models of ROA and NPM are generated in accordance to robust random effects (GLS) regressions. Table 10 provides the details of each model toward its regression coefficients and statistics.

Table-10. The regression coefficients.

Model 1. ROA				Model 2. NPM			
Variable	Coefficient	Robust Std. Error	Prob.	Variable	Coefficient	Robust Std. Error	Prob.
CADP	-.0076193	.0140323	0.587	CADP	-.164559	.1132169	0.146
LQTA	.0904126	.0187908	0.000	LQTA	.7134794	.1516094	0.000
FIDP	.000739	.0095807	0.939	FIDP	-.0105921	.0772999	0.891
NPL	-.1116645	.0469108	0.017	NPL	-1.150491	.3784899	0.002
LLP	-.2074027	.0533946	0.000	LLP	-2.17719	.4308035	0.000
DTEQ	-0.0030185	.0003868	0.000	DTEQ	-.0149338	.0031205	0.000
Constant	3.247837	1.101382	0.003	Constant	37.20324	8.886277	0.000

The results of the hypotheses test are summarized in the following part:

4.8. Liquidly risk

The results of regression coefficients in Table 10 show that liquidly risk has significant impact on banks' financial performance only when liquidity measures by LQTA ratio. The other liquidity variables (CADP and FIDP) are having insignificant relationship with banks' financial performance. An increase of LQTA ratio by one unit can lead to increase of ROA and NPM ratios by (0.0904) and (0.7134) respectively, when other factors are held constant. The positive significant impact of LQTA ratio on the profitability of Sudanese banks can be justified by the philosophy of these banks in maintaining more liquid assets to meet the large portions of depositors' funds that take a form of current account. Accordingly, the banks tend to invest in short-term investment and Islamic Sukuk in order to achieve the goal of improving the profitability as well as reducing liquidity shortage. The positive impact of LQTA on banks' financial performance has also been evidenced by previous studies of Abbas et al. (2019); Mustafa (2020). However, in contrary to Ben and Hamza (2015); Chowdhury et al. (2019) findings.

4.9. Credit risk

The two proxies (NPL and LLP) of credit risk show a negative and significant impact on the financial performance of Sudanese banks, as shown in Table 10. This implies that an increase of nonperforming ratio by one unit will reduce the ROA by (0.1116) and NPM by (1.1504) units, respectively, when all other variables are constant. Additionally, the increase of loan (financing) loss provision ratio by one unit leads to decrease in ROA and NPM by (0.2074) and (2.1771) units, respectively. The adverse relationship between credit risk and banks' financial performance is an expected result. As the failure of banks' counterparties to settle their loan (financing) will increase the operational costs and probably reduce the liquidity of banks. The result of adverse impact of credit risk on banks' financial performance that measured in form of profitability is in agreement with previous studies of Tafri et al. (2009); Bace (2016); Elgadi (2016); Al-Rdaydeh et al. (2017); Mustafa (2019); Amaliah and Hassan (2019); Abbas et al. (2019).

4.10. Financial Leverage

The regression coefficients results indicate that the financial leverage of Sudanese banks has a negative and significant impact on their financial performance. This implies that the more relying on external funds to finance the banks' assets will increase the risk that adversely affect the profitability. Moreover, the higher the financial leverage or gearing ratio may drive to increase the cost of finance that tends to reduce banks' profitability. The results that shown in Table 10 provide that a one unit increase of financial leverage will reduce the return on assets ratio by (0.0030) and the net profit margin by (0.0149), assuming all other factors are constant. This finding is matched the study of Elgadi (2016) however in an opposite view of Sarwar (2018); Menacer et al. (2019) studies.

We can conclude that the regression coefficients provide evidences to not reject the hypotheses H3, H4, H5, and H6, whereas the study rejects H1 and H2.

5. Conclusions

The study investigated the impact of liquidity risk, credit risk and financial leverage on the financial performance of Sudanese banks during the period from 2008 to 2018. A secondary data from 13 banks has been analysed using panel data estimates throughout two models, namely return on assets and net profit margin. The econometric diagnostics provide evidences that robust random effects (GLS) regression is the appropriate estimation to be applied for testing the hypotheses of the study. The regressions results reveal that credit risk measures and financial leverage are highly significant with an adverse impact on the financial performance of Sudanese banks. Additionally, two out of three liquidity risk metrics provide insignificant impact on the financial performance of Sudanese banks.

The study recommends that Sudanese banks have to manage their credit risk by relaying on the diversification of their investment portfolio. Concentration of Sudanese banks on a few types of financing such as Murabaha, Ijaraa and Salam create additional risks, therefore, banks are encouraged to diversify their investments by increasing the share of other financing modes such as Mudarabah and Mutharika. Moreover, Sudanese banks need to establish rigorous and effective credit policy, credit limits and appropriate types of collaterals. We also recommend the Sudanese banks to improve their liquidity measurement tools and management, and to attract more stable funds from capital (internal funds) in order to promote the long-term investments position. Furthermore, the study recommends the Sudanese banks to strategically focus on training and developing their staff toward the risks' identification, measurement and control.

The study provides insights for understanding and identifying risks factors that affect the financial performance in a full-fledged Islamic banking system, such as in Sudan. This can support the policy and decision makers, plus interested parties regarding risk management in Islamic banking.

We recognised the limitations of this study that include the coverage period from 2008 to 2018, the number of sampled banks of (13) banks from a population of (37) banks in Sudan, and finally the selected variables in the study do not cover all types of risks that may affect Islamic banks.

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