Bank's Financial Stability and Risk Management

Abstract

Purpose: The paper examines the effect of Saudi bank's financial stability on risk management.

Design/methodology/approach: Different OLS models have been used to study the significant effect of banks' financial stability indicatorson different types of risks in Saudi Banks.Financial statements have been collected for all Saudi banks (12 banks) from 2011 to 2014 from TADAWL website.

Findings: Our results indicate a negative and significant effect of capital adequacy ratio on credit risk. Also, there is a significant and positive effect of leverage ratio on credit risk. Moreover, our results indicate negative and significant effect of provisions, leverage, ratio of loans to deposits and bank size on liquidity risk. Finally, results indicate a positive and significant effect of capital adequacy, provisions, leverage and asset utilization ratio on operational risk and indicate a negative and significant effect of LTD ratio on operational risk.

A robustness check used to confirm our results. I find no differences between small and large Saudi banks. All banks are committed to apply Basel accord and SAMA regulations. But I find a significant difference in applying SAMA toolkits regulations between 2011 and 2014. In 2014, I find very strong results reflecting a very high degree of financial stability in Saudi banks compared to 2011 and more ability to mitigate risk exposure using different types of macroprudential toolkits stated by SAMA.

Research Limitations/implications: the study is limited to Saudi Banks from 2011 to 2014.

Originality/value: The paper is the first paper to use the macro-prudential toolkits, suggested by Saudi Arabian Monetary Agency (SAMA) as financial stability measurements, to examine their effect on different types of risks in Saudi banks. SAMA suggested this group of toolkits to comply with Basel III new regulations and to minimize the degree of risk exposure of Saudi banks.

Key words: SaudiBanks, Financial Stability, Liquidity risk, Credit risk, Operational Risk.

1. Introduction

After Basel I accord (1988) and Basel II accord (2004), a comprehensive set of reform measures designed to improve the regulation, supervision and risk management within the banking sector. The Basel Committee on Banking Supervision published the first version of Basel III in late 2009 to recover the shortcomings of Basel I and Basel II which led to 2008 financial crisis.Specifically, in response to the credit crisis, banks are required to maintain proper leverage ratios and meet certain capital requirements (Basel Committee on Banking Supervision, 2011).

The Saudi Bankscomplied withthe regulatory framework of Basel III. They continued to show strong capital adequacy and liquidity position by exceeding the requirements of Basel III accord through holding enough capital and liquidity. Furthermore, SAMA applied additional regulatory and macroprudential measures helped increase the resilience of the sector and ensure its stability to face any unexpected financial crisis and mitigate the degree of risk exposure faced by Saudi banks (SAMA, 2015).

In the MENA region, Saudi Arabia's economy is the largest with a GDP equals SAR 2,795bn (USD 745bn) in 2014. Accordingly, Saudi banking sector is large and promised sector compared to regional peers (Al-Jazira Capital, 2015).Total assets of the banking sector are equivalent to 75.6% of Saudi annual GDP and 133.2% of the non-oil GDP in 2014 (SAMA, 2015). The compounded growth rate of Saudi Banks' assets equals 9.3% with an amount of SAR 2.1 trillion from 2010 to 2014. The number of banks operating in Saudi Arabia totalled 24 at the end of 2014 including 12 branches of foreign banks and 12 National Saudi banks. All banks have 1,912 branches and about 15,516 Automated Teller Machines (ATMs). Saudi Banks continued to achieve high asset growth rates on account on-going strong economic activities in recent years (SAMA, 2015; Al-Jazira Capital, 2015).

Saudi banks credit rose by 56.3% to represent about SAR 1.25 billion in 2014. 57% of banks' credit is a corporate lending, 25.8% is consumer lending and 14.2% is loan to governments and others. The growth rate of Saudi banks credit reflects a positive indicator concerning sufficient credit for Saudi economic growth (SAMA, 2015; Al-Jazira Capital, 2015).

On the other hand, Saudi banks' non-interest bearing deposits, which considered as the primary source of finance, continued to grow to represent 71% of total banks' liabilities from 2008 to 2011. Adversely, foreign liabilities to total liabilities decreased by 5.8% at the same time period from 2008 to 2014. Accordingly, the high level of non-interest bearing deposits and the low level of foreign liabilities are reflecting a positive indicator concerning the limited exposure to interest rate risk and external financial market shocks (SAMA, 2015; Al-Jazira Capital, 2015).

Moreover, the productive and efficient position of Saudi banks reflected by a high degree of liquidity (Akhtar, 2010). Access to low cost funding and stable deposits base led to annual growth of 11% in Saudi banks' deposits between 2009 and 2014 to represent SAR 1.58

trillion in 2014. In the meantime, Saudi banks are disciplined to the regulatory loan to deposits ratio (LTD)which reflects a degree of bank liquidity. On average, the LTD ratio equals 80% between 2009 and 2014 and bank deposits covered about 125% of total bank credit in the same time period (SAMA, 2015; Al-Jazira Capital, 2015).

The previous introduction reflects the financial stability in the banking sector in Saudi Arabia. Hence, Ineed to examine the effect of Saudibanks' financial stability onrisk management. Risk management will be measured through different types of risks which include credit, liquidity and operational risks. Using data of 12 Saudi banks from 2011 to 2014, the results indicate a negative and significant effect of capital adequacy ratio on credit risk and a positive and significant effect of capital adequacy ratio on liquidity risk. Also, banks size and total debt to total equity ratio have a negative and significant effect on liquidity risk. Moreover, there is a positive and significant effect of asset utilization ratio, bank size on operational risk.

In the following section, I discuss the literature concerning main bank stability measures and risk management measures. In section three, I present the research methodology. Then, section four will discuss the main results of the study. Section five will conclude.

2. Literature Review

2.1 Financial stability measures (Independent variables)

According to Basel II, Capital requirements needed to be aligned more closely with banks' actual risks. Capital requirements, supervisory oversight, and market discipline are the main three pillars of Basel II. William Poole (2015) state that:

> *"One lesson we have learned from financial instability around the world is that financially and operationally weak financial institutions have been a key contributing factor to nearly every crisis"* (William Poole, 2015).

As mentioned before, SAMA adopted number of macroprudential proxies to support financial stability in Saudi banks. Table (1) summarize these proxy measurements:

Table 1:SAMA's Macroprudential Toolkit for the Banking Sector

Instrument	Regulatory Requirement
Capital Adequacy Ratio	Basel requirement of a Minimum of 10.5%
Provisioning	General: 1% of total loans Specific: Minimum of 100% of NPLs
Leverage Ratio	Deposits/(Capital + Reserves) ≤ 15 times
Reserve Requirement	7% for Demand Deposits 4% for Time & Saving Deposits
Loan-To-Value (LTV)	Mortgage loans ≤ 70% of residential real estate value
Debt Service – To – Income (DTI)	Monthly repayments ≤ 33% of employed salary & 25% of retired pension
Loan-to-deposit (LTD) ratio	85 %
Liquidity: Statutory Liquidity Reserve LCR (Basel III) NSFR (Basel III)	Liquid Assets/deposits ≥ 20% 100 % by 2019 (already fulfilled) 100 % by 2019 (already fulfilled)
Counterparty Exposure	Individual Exposure/total capital ≤ 25%
Foreign Exposure	SAMA approval needed before foreign lending (a qualitative measure)

Source: (SAMA, 2015), P.26.

The macroprudential measurements applied by SAMA to ensure the financial stability of Saudi banking sector and support its ability to face financial and economic crisis or unexpected events.

2.1.1 Capital Adequacy Ratio (CAP_ADQ)

Capital adequacy ratio measures the relation between capital of the bank and its risk weighted assets. According to Basel III accord, a bank's capital consists of tier 1 capital (consists of shareholders equity and retained earnings) and tier 2 capital (includes revaluation reserves, hybrid capital instruments and subordinated term debt, general loan-loss reserves, and undisclosed reserves). The minimum of capital adequacy ratio according Basel III is 8% (6% tier1 and 2% tier 2).Risk weighted assets are all assets except cash and governmental securities[1]. The weight of risky asset is identified by local regulations. For example: 50% for mortgage loans and 100% for other loans and assets.

Dalecka and konovalova (2014) state that the matter of bank capital adequacy evaluation is of great importance, and ensuring the relationship between risk and capital is one of the main conditions of financial stability

[1]Cash and governmental securities have zero credit risk (Risk free).

of banks.Many researchers examined the effect of capital adequacy and risk management. Ahmed et al., (2011) find that capital adequacy has a negative and significant relation with credit and operational risks and positive effect with liquidity risk.

2.1.2 Provisioning

According to Basel III, general provisioning must be 1% of total assets and specific provisioning must equal at least 100% of the Non-Performing Loans. The main policy of SAMA is relying on a counter-cyclical provisioning to ensure higher flexibility of the banking sector to mitigate shocks during crisis time. Consequently, in 2014, the coverage ratio for total NPLs exceeded 146 percent of total loans in some Saudi banks (SAMA, 2015). NPL to total loans or what we called coverage ratio is the best indicator of the level of provisioning in banks. Moreover, coverage ratio is one of the best macroprudential toolkits for banking sector to mitigate liquidity and credit risks.

Ahmed et al. (2011) find that NPLs ratio of Islamic banks has a negative and significant relation with operational and liquidity risks and negative and significant relation with operational risk. Muritala and Taiwo (2014) find that non-performing/assets ratio has a non-significant negative effect on bank capital. From another point of view, Hanif et al. (2012) studied the effect of risk management on non-performing loans and concluded that non-performing loans are increasing due to lack of risk management which threatens the profitability of banks.

2.1.3 Leverage Ratio

According to Basel III, leverage ratio must be less than or equal 15 times. Leverage ratio equals total deposits divided by capital + reserves. Leverage ratio equals about 12% in Saudi banks in 2014 which is less than required by Basel committee by 3% (SAMA, 2015). It represents another stability factor in Saudi banks and working as a credible supplementary measure to the risk-based capital requirements. In our study, leverage equals Deposits/ (Capital + Reserves) and according to SAMA regulations it must be less than or equal 15 times.

Saunders et al. (1990) explained that leverage ratio must be negatively related to bank risk. Ahmed et al. (2011) used debt to Equity ratio as proxy of leverage and find that leverage of Islamic banks has a negative and significant relation with operational and liquidity risks.

2.1.4 Reserve Requirements

Reserve requirement is a percentage of total deposits must be hold at the central bank (SAMA in Saudi Arabia). Finman et al. (1993) explain the history and current practices of the reserve requirements. The traditional

thinking of reserves is to ensure the liquidity of bank notes and deposits, particularly during times of financial distress. Instead, banks reserve requirements are supplementary tools for financial stability of the whole monetary system. According to Basel III and SAMA regulations, reserve requirements of demand deposits should be 7% at least. Also, reserve requirements of time and saving deposits should be 4% at least. According to Forero and Vega (2014) changes in reserve requirement affect the liquidity risk of banks.Gray (2011) supports the same idea that reserves provided some protection against both liquidity and solvency risks.

2.1.5 Loan-to-deposit (LTD) ratio

According to Basel III and SAMA (2015) regulatory requirements, the ratio of loans to total deposits must be 85% at maximum. In 14, February 2016, SAMA increased LTD ratio to be 90 at maximum. According to Fitich Ratings, the relaxation of loan-to-deposit ratio limits for Saudi Arabian banks is in response to liquidity tightening in the banking sector. The central bank increased the maximum loan-to-deposit ratio to 90% from 85% to free up liquidity, allowing banks to grow lending and invest in additional government bonds. The government plans to boost issuance of securities in the local market in 2016 to fund a growing public-sector deficit. Accordingly, I expect liquidity and credit risk will increase in the following years.Park et al, (2015) evaluated the LTD ratio as a macroprudential tool. They stated that LTD ratio is tool to avoid credit risk. Rengasamy (2014) emphasizes on the same idea that higher LTD ratio increases the liquidity risk and simultaneously decrease operational risk measured by banks' profitability.

2.1.6 Liquidity Coverage ratio (LCR)

According to Basel III, banks must hold enough high quality liquid assets (HQLA) in order to mitigate the expected liquidity risk. HOLA can be converted into cash easily and immediately to cover the liquidity needs.The Statutory Liquidity reserve which measured by LCR (liquid assets/deposits) must be 20% at least. According to SAMA (2015), Saudi banks have already fulfilled the LCR and NSFR requirements by Basel committee. The higher LCR ratio reflects low degree of liquidity risk but it may increase operational and credit risks.

2.1.7 Asset Utilization ratio (OI_TA)

One more independent variable has been added to the macroprudential factors which is the operating income to total asset ratio(OI_TA). The ratio will be used as a control variable to see the effect of Saudi banks operating income in mitigating different types of risks. Asset utilization ratio measured by dividing operating income on total assets. The higher ratio

reflects low degree of operational risk. Ahmed et al. (2011) find thatAsset management measured by OI_TA establishes a positive and significant effect on liquidity and operational risks).

2.1.8 Bank size(SIZE): (control variable)

In our study I measured bank size using total assets. Previous studies proved that bank size has an effect on risk management. Ahmed et al. (2011) find that bank size of Islamic banks has a positive and significant relation with credit and liquidity risks and negative and significant relation with operational risk.Also, Afzal and Mirza (2012) stated that larger banks were more diversified than their smaller counterparts mainly on account of their outreach and size of credit portfolio and the higher the degree of assets diversification the lower the degree of financial risks. Moreover, in an application on Nigerian commercial banks, Muritala and Taiwo (2014) find that bank liquidity has a non-significant negative effect on bank capital as a measure of bank size.

2.2 Risk management (Dependent variables)

In general, all banks face three main types of risks which are credit risk, liquidity risk and operational risk. In my paper, I concentrated on the main three types of risks and how they are affected by the degree of bank financial stability.

2.2.1 Credit Risk

According to Basel committee on banking supervision (1999) *"Credit risk is most simply defined as the potential that a bank borrower or counterparty will fail to meet its obligations in accordance with agreed terms. The goal of credit risk management is to maximise a bank's risk-adjusted rate of return by maintaining credit risk exposure within acceptable parameters".*Demrjian (2008) and Friewald et al. (2014) Explained that leverage provides measure indebtedness and considered as a measure of credit quality. High leverage reflects high credit risk and vice versa. Also, Ahmed et al. (2011) used leverage as a measure of credit risk.In this paper, I measured credit risk using leverage ratio(TD_TA) following Ahmed et al. (2011).

2.2.2 Liquidity Risk

According to Basel committee on banking supervision (2010) *"funding liquidity risk defined as the possibility that over a specific horizon the bank will become unable to settle obligations with immediacy".*Also,Liquidity risk can be defined as the chancethat thebank will not be able to meet its current and future cash flow and collateral needs, both expected and unexpected, without materially affecting its daily operations or overall financial condition. According to Farag et al. (2013)bank's capital absorb

losses that could threaten a bank's solvency. That means, it is a necessary for every bank to hold sufficient capital to mitigate liquidity risk. In this paper, I measured liquidity risk using CAP_TA ratio following Ahmed et al. (2011).

2.2.3 Operational risk

In October 2014, the Basel Committee defined operational risk as *"The risk of loss resulting from inadequate or failed internal processes, people and systems or from external events"*.Ames et al. (2015) explained that operational risk is totally different than other bank's risks. Because bank's operational risk is embedded in every process, person, system and external events of the bank and accordingly it is very difficult to measure.Diallo et al. (2015) measured operational risk using operational expenses to operational revenues ratio. According to Kulpaand Magdon (2012) 64% of operational risk comes from bank's processes and different simplified, standard and advanced approaches used to measure operational risk. Because bank's net income reflects the quality of its processes,in this paper, I measured operational risk using net income to total assets (NI_TA) ratio following Ahmed et al. (2011) and the simplified approach explained by Kulpa and Magdon (2012).

3. Methodology

3.1 Research Hypothesis

Based on our literature, I expect that the Macroprudential toolkits applied by Saudi banks will have a negative effect on different types of risks. All Financial stability tools (dependent variables) will mitigate the degree of risk exposure faced by Saudi banks. Accordingly, I hypnotized that:

H1:"There is a significant and negative effect of bank's financial stability on credit risk".
H2: "There is a significant and negative effect of bank's financial stability on liquidity risk".
H3: "There is a significant and negative effect of bank's financial stability on operational risk".

3.2 Research models

According to Denham (2010) OLS regression model, as a parametric statistical technique, is the most commonly used technique to examine the effect of multiple independent variables on a dependent variable. Vast number of research in the area of risk management and financial stability has used OLS regression models

(Yaganti et al. (2015);Ahmed et al. (2011)).In general, I used bank's financial stability proxies as independent variables and risk proxies measures as dependent variables. All variables and their definitions are listed in table 2.I used three OLS models. In each model I used different type of risks as follow:

Model (1):

$$TD\_TA = \alpha + CAP\_ADQ\beta1 + NPL\_TL\ \beta2 + DEP\_CAP\_RES\ \beta3 + REG\_RES\_DEP\beta4 + LTD\ \beta5 + LIQUIDITY\ \beta6 + OI\_TA\ \beta7 + SIZE\ \beta8 + \varepsilon$$

Model (2):

$$CAP\_TA = \alpha + CAP\_ADQ\ \beta1 + NPL\_TL\ \beta2 + DEP\_CAP\_RES\ \beta3 + REG\_RES\_DEP\beta4 + LTD\ \beta5 + LIQUIDITY\ \beta6 + OI\_TA\ \beta7 + SIZE\ \beta8 + \varepsilon$$

Model (3):

$$NI\_TA = \alpha + CAP\_ADQ\ \beta1 + NPL\_TL\ \beta2 + DEP\_CAP\_RES\ \beta3 + REG\_RES\_DEP\beta4 + LTD\ \beta5 + LIQUIDITY\ \beta6 + OI\_TA\ \beta7 + SIZE\ \beta8 + \varepsilon$$

Where:
TD_TA is a proxy of credit risk
CAP_TA is a proxy of liquidity risk
NI_TA is a proxy of operational risk
α is the intercept of the model
$\beta1$ to $\beta8$ are slopes of the each variable
CAP_ADQ is the ratio of capital adequacy
NPL is a proxy of provisioning
DEP_CAP_RES is a proxy of leverage
REG_RES_DEP is a proxy of regular reserves ratio to total deposits
LTD is the ratio of total loans to total deposits
LIQUIDITY is the ratio of liquidity
OI_TA is a proxy of asset utilization ratio
SIZE is a bank total assets as a proxy of its size
ε is the error term

Table 2
Variables and definitions

Variables	Abbreviation	Definition
Dependent Variables:		
Credit Risk	TD_TA	Total debt to Total asset
Liquidity Risk	CAP_TA	Total capital to total assets
Operational Risk	NI_TA	Net Income to total Assets
Independent Variables:		
Capital Adequacy Ratio	CAP_ADQ	(Tier1 capital + Tier2 Capital) /Risk Weighted Asset
Provisioning (NPL Ratio)	NPL_TL	Total non-performing loans to total loans
Leverage ratio	DEP_CAP_RES	(Deposits/(Capital + Reserves)
Reserve Requirements	REG_RES_DEP	(Regular Reserves/Deposits)*100
Loan to Deposits ratio	LTD	Total loans to total deposits
Liquidity Ratio	LIQUIDITY	(Liquid assets/Deposits)
Asset Utilization Ratio	OI_TA	Operating income to total assets
Control Variables:		
Bank size (SR Million)	SIZE	Total assets of the bank

3.3 Population

As all Saudi banks listed on the stock market and all data are available online,I used a complete census approach. Our population includes 12 Saudi banks. All banks included in this study are reported in table 3.

Table 3: Saudi banks (Population of study)

No	Bank Name
1	The National Commercial Bank
2	The Saudi British Bank
3	Saudi Investment Bank
4	Alinma Bank
5	Saudi Fransi Bank
6	Riyad Bank
7	Samba Financial Group
8	Saudi Hollandi Bank
9	Al Rajhi Bank
10	Arab National Bank
11	Al-Bilad Bank
12	AlJazira Bank

Source: TADAWL web site.

3.4 Data collection

This study utilizes financial data of Saudi banks from 2011 to 2014. All data have been collected from "TADAWL" website as the formal website of Saudi stock market. All 12 banks are listed in Saudi stock market and all financial reports and statements are disclosed in the stock market website.

4. Empirical Results

4.1 Descriptive statistics

Table (4) shows descriptive statistics of dependent and independent variables. The average of credit risk proxy(TD_TA) is about 85% with minimum 56% and maximum 91% approximately. The ratio reflects the degree of credit risk, the higher the ratio, the higher the degree of credit risk. Accordingly, Saudi banks have a higher degree of credit risk. The liquidity risk proxy (CAP_TA) has an average of 8.32% with a minimum of 3.98% and a maximum of 40.78. The lower the degree of the ratio, the lower the degree of liquidity risk because the increase of banks' Capital will minimize the probability of facing liquidity risk.Accordingly, Saudi banks have a higher degree of liquidity risk as the average is equals about 8.5%. Also, the operational risk proxy (NI_TA) has a mean of 1.87%, minimum 0.78% and maximum 3.34%. The higher levels of the ratio mean the lower the degree of operational risk as the ratio reflects the net income to total assets. That means Saudi banks have a higher degree of operational risk as the ratio is too low compared to other industries.

On the other side, concerning the independent variables, the macroprudential factors applied by Saudi bank are supporting bank's financial stability. For example, Capital Adequacy ratio (CAP_ADQ) has a mean of 16.66% with a minimum of 10.26% and a maximum of 44.94%. By comparing this ratio with the minimum requirements of Basel III (see table 1), I find that all Saudi banks are complied with BASEL III requirements (minimum 10.5%). Descriptive statistics of the rest of macroprudential factors as shown in table 4 are achieving the minimum and maximum requirements of Basel III.

Concerning asset utilization ratio (OI_TA), it has an average of 3.67 which is little bit low. Also, Banks' size, measured by total assets, has an average of SAR 149,838 million, minimum SAR 27,727 million and maximum SAR 434,878 million approximately. Later, I will examine the effect of bank size as a control variable on bank financial stability and a way to mitigate risk exposure.

Table (4)
Descriptive Statistics

	N	Minimum	Maximum	Mean	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
TD_TA	48	56.8	90.7	85.040	-3.355	.343	13.694	.674
CAP_TA	48	4.0	40.8	8.320	3.376	.343	12.720	.674
NI_TA	48	.8	3.3	1.866	.469	.343	1.376	.674
CAP_ADQ	48	10.3	44.9	16.660	3.118	.343	12.330	.674
NPL_TL	48	.0	6.7	1.783	1.976	.343	4.723	.674
DEP_CAP_RES	48	1.2	10.3	7.039	-.959	.343	1.206	.674
REG_RES_DEP	48	.6	9.4	5.185	-.493	.343	-.357	.674
LTD	48	.0	136.9	67.190	-1.303	.343	2.323	.674
LIQUIDITY	48	13.1	53.3	22.077	1.731	.343	3.727	.674
OI_TA	48	2.5	5.8	3.670	1.466	.343	1.687	.674
SIZE (SR Thousand)	48	27727169.0	434878084.0	149838358.917	.888	.343	.453	.674

4.2 Pearson correlation

The values of Pearson Correlation Coefficients are reported in Table (3) indicates that the problem of multicolinearity does non-exist between the independent variables. Only, the Pearson correlation between CAP_ADQ and DEP_CAP_RES equals (-0.845). Accordingly, I will consider the probability between these two ratios in our regression to avoid the problem of multicollinearity[2].

[2] The rule of thumb is that any VIF of 10 or more provides evidence of serious multicollinearity (Cohen et al., 2003).

Table (5)
Pearson Correlation between Macroprudential Toolkits

		CAP_ADQ	NPL_TL	DEP_CAP_RES	REG_RES_DEP	LTD	LIQUIDITY	OI_TA	SIZE
CAP_ADQ	Pearson Correlation	1	-.291*	-.845**	-.281	.425**	.292*	.006	-.251
	Sig. (2-tailed)		.045	.000	.053	.003	.044	.969	.086
	N	48	48	48	48	48	48	48	48
NPL_TL	Pearson Correlation	-.291*	1	.167	.013	-.424**	.480**	.238	-.125
	Sig. (2-tailed)	.045		.256	.931	.003	.001	.103	.397
	N	48	48	48	48	48	48	48	48
DEP_CAP_RES	Pearson Correlation	-.845**	.167	1	.113	-.359*	-.322*	.000	.333*
	Sig. (2-tailed)	.000	.256		.445	.012	.026	.998	.021
	N	48	48	48	48	48	48	48	48
REG_RES_DEP	Pearson Correlation	-.281	.013	.113	1	-.097	-.553**	-.209	.425**
	Sig. (2-tailed)	.053	.931	.445		.511	.000	.154	.003
	N	48	48	48	48	48	48	48	48
LTD	Pearson Correlation	.425**	-.424**	-.359*	-.097	1	-.196	-.712**	-.332*
	Sig. (2-tailed)	.003	.003	.012	.511		.183	.000	.021
	N	48	48	48	48	48	48	48	48
LIQUIDITY	Pearson Correlation	.292*	.480**	-.322*	-.553**	-.196	1	.408**	-.507**
	Sig. (2-tailed)	.044	.001	.026	.000	.183		.004	.000
	N	48	48	48	48	48	48	48	48
OI_TA	Pearson Correlation	.006	.238	.000	-.209	-.712**	.408**	1	.154
	Sig. (2-tailed)	.969	.103	.998	.154	.000	.004		.297
	N	48	48	48	48	48	48	48	48
SIZE	Pearson Correlation	-.251	-.125	.333*	.425**	-.332*	-.507**	.154	1
	Sig. (2-tailed)	.086	.397	.021	.003	.021	.000	.297	
	N	48	48	48	48	48	48	48	48

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

4.3 OLS regression results

"Meeting the assumptions of regression analysis is essential to ensure that the results obtained are truly representative of the sample and we obtain the best result possible" (Hair et al., 2006, p. 70). Before running the regression analysis, the data were checked to evaluate the regression analysis assumptions. All variables were checked for normality of distribution and found to be non-normally distributed (in most cases). To solve the normality problem, steps were taken to transform the data. I utilized the normal scores of the dependent variables using Van der Waerden's. After the transformation of data using Van der Waerden's Formula, I examined Skewness and Kurtosis for all variables. Based on the measures of Skewness and Kurtosis, the distribution of the data set resembles a normal distribution for all variables, as the Z-tests for Skewness and Kurtosis ratios were within ±1.96. Also, I find that all the dependent variables have p-values > 0.05 using the Kolmogorov-Smirnov test of normality. Accordingly, I accept the assumption of normality for all variables after data transformation. Moreover, during the regression analysis I checked multicollinearity using the Variance Inflation Factor (VIF) for each variable. Finally, hetroskedasticity was examined for all regressions using the BreuschPagan/Cook-Weisberg test[3].

4.3.1 Credit risk

Table (6) explained the OLS model which examinesthe effect of banks financial stability measures on credit risk. The adjusted R Square of the model equals 0.970 which means that our independent variables explained 97% of changes in credit risk measured by TD_TA. The model is significant at 1% (F=190.703). The results of the model indicate a negative and significant effect of capital adequacy ratio on credit risk. That means, the higher degree of capital adequacy ratio in Saudi banksmitigate the degree of credit risk. Also, there is a significant and positive effect of Leverage ratio on credit risk. That means the higher degree of leverage increase the degree of credit risk. Based on these results, Saudi banks should increase capital adequacy ratio and minimize leverage ratio to mitigate the degree of credit risk. I accept our first hypothesis.All other variables have no significant relation with credit risk proxy.

[3] The rule of thumb for the Breusch-Pagan/Cook-Weisberg test for hetroskedasticity depends on the P value of chi2. If the P value of chit > 0.05 we reject the null hypothesis of hetroskedasticity.

Table (6) the effect of Macroprudential Toolkits on Credit Risk

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-1.013E-5	.024		.000	1.000		
	Normal Score of CAP_ADQ	-.883	.047	-.883	-18.845	.000	.291	3.435
	Normal Score of NPL_TL	.033	.043	.033	.757	.453	.346	2.886
	Normal Score of DEP_CAP_RES	.130	.054	.130	2.406	.021	.219	4.570
	Normal Score of REG_RES_DEP	-.020	.039	-.020	-.518	.608	.424	2.361
	Normal Score of LTD	.005	.048	.005	.109	.914	.275	3.631
	Normal Score of LIQUIDITY	.051	.038	.051	1.333	.190	.441	2.267
	Normal Score of OI_TA	-.008	.033	-.008	-.249	.804	.583	1.715
	Normal Score of SIZE	-.025	.043	-.025	-.581	.565	.338	2.956

Model Summary		**ANOVA**	
R Square	Adjusted R Square	F	Sig.
.975	.970	190.703	.000

4.3.2 Liquidity Risk

Table (7) explained the OLS model which examines the effect of banks financial stability on liquidity risk. The adjusted R Square of the model equals 0.903 which means that our independent variables explained 90.3% of changes in credit risk measured by CAP_TA. The model is significant at 1% (F=55.755). The results of the model indicate negative and significant effect of provisions, leverage, ratio of loans to deposits and bank size on liquidity risk. That means,Saudi banks macroprudential toolkits which include provisions, leverage, ratio of loans to deposits and bank size (as a control variable) mitigate the degree of liquidity risk. Accordingly, I accept our second hypothesis. All other variables have no significant effect on liquidity risk proxy.

Table 7 The effect of Macroprudential Toolkits on Liquidity Risk

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.000	.042		.008	.993		
	Normal Score of CAP_ADQ	-.284	.084	-.284	-3.372	.002	.291	3.435
	Normal Score of NPL_TL	-.188	.077	-.188	-2.442	.019	.346	2.886
	Normal Score of DEP_CAP_RES	-.978	.097	-.978	-10.073	.000	.219	4.570
	Normal Score of REG_RES_DEP	-.107	.070	-.107	-1.537	.132	.424	2.361
	Normal Score of LTD	-.161	.087	-.160	-1.847	.072	.275	3.631
	Normal Score of LIQUIDITY	.029	.068	.029	.430	.670	.441	2.267
	Normal Score of OI_TA	.096	.059	.096	1.607	.116	.583	1.715
	Normal Score of SIZE	-.381	.078	-.381	-4.880	.000	.338	2.956

Model Summary		**ANOVA**	
R Square	Adjusted R Square	F	Sig.
.920	.903	55.755	.000[b]

a. Dependent Variable: Normal Score of CAP_TA using Van der Waerden's Formula

4.3.3 Operational Risk

Table (8) explained the OLS model which examines the effect of banks financial stability on operational risk. The adjusted R Square of the model equals 0.595 which means that our independent variables explained 59.5 % of changes in operational risk measured by NI_TA. The model is significant at 1% (F=9.617). The results of the model indicate a positive and significant effect of capital adequacy, provisions, leverage and asset utilization ratio on operational risk and indicate a negative and significant effect of LTD ratio on operational risk. The results support our third hypothesis. The macroprudential tools will mitigate the degree of operational risk. Considering that Basel III encouraged Saudi banks to minimize LTD ratio. All other variables have no significant relation with operational risk proxy.

Table 8 The effect of Macroprudential Toolkits on Operational Risk

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	.001	.086		.009	.993		
	Normal Score of CAP_ADQ	.529	.172	.529	3.071	.004	.291	3.435
	Normal Score of NPL_TL	-.187	.158	-.186	-1.182	.244	.346	2.886
	Normal Score of DEP_CAP_RES	.392	.199	.392	1.973	.056	.219	4.570
	Normal Score of REG_RES_DEP	.260	.143	.260	1.823	.076	.424	2.361
	Normal Score of LTD	-.359	.178	-.357	-2.016	.051	.275	3.631
	Normal Score of LIQUIDITY	-.153	.140	-.153	-1.096	.280	.441	2.267
	Normal Score of OI_TA	.433	.122	.433	3.558	.001	.583	1.715
	Normal Score of SIZE	.102	.160	.102	.641	.526	.338	2.956

Model Summary		**ANOVA**	
R Square	Adjusted R Square	F	Sig.
.664	.595	9.617	.000[b]

a. Dependent Variable: Normal Score of NI_TA

4.4 Robustness analysis:

To check the robustness of our results, I split our data into two samples. I use the mean of bank size (total assets= SR 149,838,359,000) to split the sample into small banks (less than mean) and large banks (over the mean). I repeat the same regression models using the same macroprudential tools to study its effect on different types of risks. I exclude bank size from our independent variables as I already split our data according to bank size.

Table 9 summarizes the results of the effect of financial stability measures in Saudi large banks on different types of risk. All models are significant 5% level and R square equals 50.6; 92.6 and 53.1% for credit, liquidity and operational risk respectively. The results indicated a significant and positive effect of provisions on credit risk; significant and negative effect of provisions and leverage on liquidity risk and significant and negative relation between LTD ratio and operational risk. The results support the same results in tables 6, 7, and 8. Accordingly, large Saudi banks are able to mitigate the different types of risks.

Table 9the effect of Macroprudential Toolkits on Risks' types of large banks

		Credit Risk		Liquidity Risk		Operational Risk	
		B	Sig	B	Sig	B	Sig
1	(Constant)	.000	.999	-5.045E-5	.999	-6.483E-5	1.000
	Normal Score of NPL_TL	-.291	.249	-.101	.299	-.130	.591
	Normal Score of DEP_CAP_RES	.810	.035	-1.143	.000	.006	.986
	Normal Score of REG_RES_DEP	-.031	.909	-.358	.003	.186	.491
	Normal Score of LTD	.211	.603	.012	.939	-.719	.082
	Normal Score of LIQUIDITY	.218	.326	.034	.691	.043	.840
	Normal Score of OI_TA	.233	.490	.112	.393	.112	.732
R Square		.506		.926		.531	
F		2.729	.051	33.337	.000	3.024	.036

To see if there are differences between large and small banks, I repeat the same regression using data of small banks. Table 10 summarizes the effect of macroprudential tools on different types of risks. All models are significant at 5% level. R Squares equals

97.5, 95.1 and 51.9 for credit, liquidity and operational risks respectively. The results support the same results in tables 6, 7, and 8. Accordingly, there is no difference between Saudi banks, large or small,in mitigating different types of risk. Also, the results are confirming the commitment of all Saudi banks to apply Basel III requirements and complying with SAMA regulations. Moreover, the results are confirming the financial stability of Saudi Banking sector.

Table 10the effect of Macroprudential Toolkits on Risks' types of small banks

		Credit Risk		Liquidity Risk		Operational Risk	
		B	Sig	B	Sig	B	Sig
1	(Constant)	-6.564E-5	.998	.000	.993	.000	.999
	Normal Score of CAP_ADQ	-.637	.000	-.352	.042	.855	.107
	Normal Score of NPL_TL	.104	.248	-.214	.094	-.140	.716
	Normal Score of DEP_CAP_RES	.362	.002	-1.104	.000	.779	.091
	Normal Score of REG_RES_DEP	-.103	.132	-.152	.110	.423	.153
	Normal Score of LTD	.038	.715	-.247	.101	-.083	.856
	Normal Score of LIQUIDITY	.012	.887	.284	.021	-.185	.605
	Normal Score of OI_TA	-.060	.295	.056	.477	.596	.025
R Square			.975		.951		.519
F		92.848	.000[b]	47.592	.000[b]	2.625	.049[b]

Another robustness check has been examined to see the effect of applying macroprudential toolkits to comply with Basel III and SAMA regulations. I repeated the same regression models using sample data of 2011 (before Basel III) and sample data of 2014 (after Basel III and commitment with macroprudential toolkits).

Table 11 summarizes the results of the effect of financial stability measures on different types of risks. The results are totally different than previous models. Liquidity and operational risks models are insignificant at 10% levels using 2011 data. Credit risk model are significant at 5% level and the results indicate a negative and significant relation between capital adequacy and credit risk. This result is the only consistent result with our previous models.

Table 11the effect of Macroprudential Toolkits on Risks' types in 2011

		Credit Risk		Liquidity Risk		Operational Risk	
		B	Sig	B	Sig	B	Sig
1	(Constant)	-1.025E-6	1.000	1.543E-5	1.000	.000	.999
	Normal Score of CAP_ADQ	-.748	.045	-.308	.508	.240	.666
	Normal Score of NPL_TL	.001	.996	-.018	.965	-.320	.539
	Normal Score of DEP_CAP_RES	.243	.316	-.780	.125	.815	.170
	Normal Score of REG_RES_DEP	-.120	.575	.016	.966	.624	.242
	Normal Score of LTD	-.049	.829	.044	.914	-.150	.768
	Normal Score of LIQUIDITY	.196	.391	-.043	.912	.374	.458
	Normal Score of OI_TA	-.025	.869	.266	.381	.252	.485
	Normal Score of SIZE	.100	.652	-.565	.220	.202	.684
R Square		.973		.909		.862	
F		13.355	.028[b]	3.728	.153[b]	2.351	.260[b]

Table 12 shows the results of year 2014 data. All models are significant at 1% level. R Squares of the three models equal 99.7, 98.8, and 99% for credit, liquidity, and operational risks. The results are very strong results reflecting a very high degree of financial stability in Saudi banks in 2014 compared to 2011 and more ability to mitigate risk exposure using different types of macroprudential toolkits stated by SAMA.

Table 12the effect of Macroprudential Toolkits on Risks' types in 2014

		Credit Risk		Liquidity Risk		Operational Risk	
		B	Sig	B	Sig	B	Sig
1	(Constant)	1.225E-16	1.000	3.588E-16	1.000	-1.838E-17	1.000
	Normal Score of CAP_ADQ	-1.074	.001	-.218	.305	.671	.027
	Normal Score of NPL_TL	-.098	.376	-.334	.176	.192	.355
	Normal Score of DEP_CAP_RES	.036	.730	-1.019	.012	.126	.523
	Normal Score of REG_RES_DEP	.131	.176	-.039	.812	.077	.614
	Normal Score of LTD	.167	.090	-.270	.140	-.082	.563
	Normal Score of LIQUIDITY	.052	.447	-.086	.521	-.510	.019
	Normal Score of OI_TA	.181	.225	.253	.365	.558	.086
	Normal Score of SIZE	.041	.546	-.691	.010	.106	.414
R Square		.997		.988		.990	
F		129.056	.001	31.885	.008	36.809	.007

5. Conclusion and future research

A group of macroprudential toolkits have been applied by SAMA as a response to Basel accord. These group of toolkits used as a risk management hedging mechanisms. I examine the effect of the macroprudential tools on risk management in Saudi banks. Our results indicate a negative and significant effect of capital adequacy ratio on credit risk. Also, there is a significant and positive effect of leverage ratio on credit risk. Moreover, our results indicate negative and significant effect of provisions, leverage, ratio of loans to deposits and bank size on liquidity risk. Finally, results indicate a positive and significant effect of capital adequacy, provisions, leverage and asset utilization ratio on operational risk and indicate a negative and significant effect of LTD ratio on operational risk.

A robustness check used to confirm our results. I find no differences between small and large Saudi banks. All banks are committed to apply Basel accord and SAMA regulations. But I find a significant difference in applying SAMA toolkits regulations between 2011 and 2014. In 2014, I find very strong results reflecting a very high degree of financial stability in Saudi banks compared to 2011 and more ability to mitigate risk exposure using different types of macroprudential toolkits stated by SAMA.

SAMA and Saudi banks' boards must support macroprudential toolkits suggested as they reflect strong risk management tools. Other Gulf countries, which follow SAMA regulations, must follow the same tools to mitigate their banks' risk exposure. An international comparative study could be done to examine the same effect of hedging tools on risk management in banking sector.

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APPENDIX

Table 1. A comparison between banks and other sectors concerning Stock Market Capitalization (Billion SAR)

Sector	Number of Firms	2013	2014	Y-to-Y Change (%)
Banks & Financial Services	12	380.04	513.82	35.20
Petrochemical Industries	14	554.65	423.28	-23.68
Cement	14	90.93	90.81	-0.13
Retail	14	50.10	75.99	51.68
Energy & Utilities	2	62.62	64.52	3.04
Agriculture & Food Indust.	16	93.97	122.68	30.55
Telecom. & Information Tech	5	187.58	175.73	-6.31
Insurance	35	36.85	39.77	7.91
Multi-Investment	7	97.48	73.58	-24.52
Industrial Investment	14	55.45	57.52	3.73
Building & Construction	17	27.59	27.89	1.10
Real Estate Development	8	78.60	99.22	26.24
Transport	4	15.09	19.83	31.44
Media & Publishing	3	4.79	3.81	-20.53
Hotel & Tourism	4	17.12	24.43	42.72
Total	**169**	**1,752.86**	**1,812.89**	**3.43**

Source: SAMA (2015)