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RESEARCH ARTICLE

Improving the Robustness of Capital and Risk Relationship Estimation: A Fundamental Analysis

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Abstract: This study explores the relationship between capital ratio, hazard-based capital ratio, capital buffer ratio and portfolio hazard pre, pro and post-crisis time of US banks over the extended period of 2002 and 2018. The overall results show that the capital ratio, all-out risk-based capital ratio and risk-taking are decidedly related. The adjustment in hazard taking against capital ratio is lower during and post-crisis periods. Notwithstanding, the impact of risk-based capital ratio and the capital bufferis negative and more articulated in the post-crisis period than before. The relationship between hazard- taking and capital ratios are heterogeneous for well, sufficiently, undercapitalized, high and low liquid banks. The outcomes have financial ramifications for controllers to define policies.

Keywords: Insured Banks, Crisis Period, Capital Ratios, Risk
JEL Classification Code: G21, G32

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1 Introduction

Over the last few decades, the world monetary system has undergone tremendous changes. Globalization has widened the debate in banking territories in developed and developing economies around the globe. Globalization and technological change have called on financial associations to become modern creative financial products to satisfy stakeholders' needs. Nonetheless, these advancements are joined by some hazards in the financial segment. The controllers have been attempting to give a general model to deal with the bank capital since Basel I was introduced in 1988. It was followed by Basel II that was presented in 2004. The latest Basel III has been dynamic since 2010. The monetary crunch 2007-2008 demonstrated that the higher proportion of capital was not fit for saving banks. Basel II's insufficiencies were an intention to grow new and more proper rules to fill this hole in the financial framework. The Basel Committee on Banking and Supervision (BCBS) gave new rules to banking oversight under the title "Basel-III" in 2010. The Basel Accord-III gives new meanings of bank capital and bank liquidity. The basic purpose of Basel III is to enhance the bank equity base and to strengthen banks' liquidity position. Basel-III provides three different proxies of bank capital in addition to the requirements of Basel-II.

The first measure is the capital adequacy rate, which should be 8% of banks' risky assets. The second measure is the tier-one ratio, which requires a 6% ratio of tier-one capital against banks' risky assets. The third proxy measure is the tier-one capital ratio of at least 4.5% of risky assets. Surprisingly, the increase in the capital level always remains the primary focus for regulators to reduce the probability of failure, as witnessed in earlier literature (Bitar et al., 2018; Jacques & Nigro, 1997). In light of the available literature, the importance and sustainability of a financial system needed to answer the following key questions regarding the association of different capital ratios and banks' portfolio risk in the post-crisis period. First, how does a change in total capital ratio, total risk-based capital ratio and capital buffer ratio affect a bank's risk-taking in the post-crisis period in comparison with the before-crisis and during-crisis period?Do the well-capitalized banks' capital ratios influence risk differently from adequately and under-capitalized insured commercial banks? Do the high-liquid insured commercial banks' capital ratios influence risk differently from low-liquid insured commercial banks? Although a plenty of studies explore the relationship between bank capital ratios and bank risk-taking (Abbas & Ali, 2020; Abbas, Butt, et al., 2019; Abbas, Iqbal, & Aziz, 2019; Abbas & Masood, 2020; Bitar et al., 2018) but evidence lack especially for well-capitalized, adequately-capitalized, under-capitalized, high-liquid and low liquid banks in the USA context.

Theoretically, there have been various hypotheses reported in the banking literature about the relationship between risk-taking and adjustment of bank capital ratios. For example, the mean-variance hypothesis suggests a positive relationship between capital and risk (Kim & Santomero, 1988; Rochet, 1992), whereas the option pricing theory concluded an inverse association between capital and risk (Keeley & Furlong, 1990). The moral hazard hypothesis supports the negative association between risk and capital ratios (Lee & Hsieh, 2013; Zhang et al., 2008). According to the moral hazard theory, bank managers normally exploit the depositor's rights in that they primarily favor their own interest for managerial compensation and secondly support the interest of shareholders for their wealth maximization. The regulatory hypothesis theory favors the positive relationship between capital and risk as evidenced in the literature (Altunbas et al., 2007; Ding & Sickles, 2018). According to the regulatory theory, banks are bound to increase their capital level with increased

portfolio risk. The positive connection between risk and capital suggested by regulators to reduce the problem of bankruptcy due to greater risk and lower capital.

The results of this study have an economic significance for regulators to consider further regulation about the adjustment of bank capital ratios and risk in order to mitigate the probability of failure. The results are not similar to the previous studies and require deep attention to formulate appropriate guidelines. For example, Aggarwal & Jacques (1998) found a negative coefficient of lagged risk in their results,whereas the sign is positive and highly significant in the present study results, which is consistent with Jokipii & Milne (2011). The findings indicate that there is a need to revise and develop a new model according to present economic conditions and this study is a step to do such.

This study explores the connection between risk and capital in the USA. This study used the sample of insured commercial banks from the USA with consolidated assets of $300 million or above covering the period between 2002 and 2018. The model is estimated based on the two-step system GMM approach,which incorporates the endogeneity of risk and capital ratios.The study conducted by Aggarwal & Jacques (1998) used 2552 banks having assets of $100 million or above as reported between 1990 and 1993. Shrieves & Dahl (1992) used a sample of USA banks (1984 and 1986). Jacques & Nigro (1997) used a sample of 2570 banks of the USA (1990 and 1991). Jahankhani et al. (1979) conducted a study using the data of 95 banks from the USA over the period between 1972 and 1976. Pettway (1976) used a sample of the USA banks and covered the period between 1971 and 1974. Shim (2010) used the USA companies to study the relationship between risk and capital, covering 1993 and 2004.

This study contributes to the literature by providing the latest insights into bank capital and the risk of the world's most regulated economy. To the best of the researchers' knowledge, this is the first study in the post-crisis period covering the Basel-II, Basel-III and crisis period of 2007-2009. In addition, this is the first study in the post-crisis period, which provides a deep analysis for risk and capital by dividing the banks according to their capitalization and liquidity in the USA. The findings are critical for regulators to observe the differences between pre, pro and after-crisis periods for the well, adequately, under, significantly under-capitalized, high liquid, and low-liquid banks of the USA. Generally, other studies are limited to use capital ratios measured as equity to total assets while studying the relationship between risks as measured risk-weighted assets and total assets. This study provides new insights into the influence of risk-based capital ratio and capital buffer ratio for the post-crisis period compared with before-crisis and during-crisis periods.The results guide future decision making to develop regulations for the stability of the financial system. The findings are significant because they cover the period of technological transformation and global integration of the world. The study also highlights the effect of recently developed regulations of holding a greater amount of capital on risk.

2 Literature Review

In the recent years, various studies examine the impact of bank capital on bank risk-taking (Jiang et al., 2020; Khan et al., 2017; Laeven et al., 2016; Lee & Hsieh, 2013; Mahdi & Abbes, 2018; Moudud-Ul-Huq, 2019; Raz, 2018; Rehman et al., 2019) but the conclusion remains mixed. The theorem of Modigliani & Miller (1958) states that the market is fully efficient and perfect in the sense that depositors are fully informed about the true risk of their finan-

cial institutions. This situation depicts that equity holders cannot exploit the depositors.If the depositors claim greater rates against the banks' true riskiness; this means that equity holders cannot use their vigilant position to increase their own interest on the cost of depositors in the short-run. Under this condition, the value of the bank will remain independent of the debt and equity mix. Sealey Jr (1983) claims that the MM theory is not useful in banking capital structure. They state that depositors are not fully informed about the riskiness of bank assets. Therefore, they cannot monitor their banks. This situation provides an edge to the bank managers to take greater risk, which is known as a moral hazard in banking.

Jensen & Meckling (1976) argue that if depositors are unable to sign a perfect agreement with bank managers, shareholders have an edge to invest in more risky assets. The moral risk-hypothesis is additionally upheld by Green (1984) and Galai & Masulis (1976). Numerous hypothetical and observational examinations have researched the relationship between bank risk-taking and capital. For instance, by applying the mean-change theory (Kahane, 1977; Koehn & Santomero, 1980) presumed that hazard-based capital lifts the risk. However, Furlong & Keeley (1989) clarified that hazard-based capital does not expand bank risk. Shrieves & Dahl (1992) affirmed the positive connection between changes in capital and risk in their examination by utilizing USA banking information. Interestingly, Aggarwal & Jacques (1998) and Jacques & Nigro (1997) applied a comparative strategy and closed a backward relationship between hazard and capital.

Lee & Hsieh (2013) inspected the impact of capital proportion on hazard taking of Asian business banks covering 1994 to 2008. They record a reverse connection between risk and capital proportion. They contend that the ethical risk hypothesis support the negative relationship between risk and capital. Zhang et al. (2008) expressed the negative connection between risk and bank value. Altunbas et al. (2007) clarified that the connection between risk and capital is positive for commercial banks and negative for agreeable banks. Jokipii & Milne (2011) uncovered a positive relationship between hazard and the bank value level in the USA. Athanasoglou (2011) supported the positive relationship in the Southeastern area. Essentially, Teply et al. (2007) and Kufo (2015) favor the positive connection theory. Then again, Akinsoyinu et al. (2015) revealed a converse relationship between change in capital level and bank risk. The negative relationship is observationally upheld by the investigation of (Ghosh, 2014). Godlewski (2005) featured a negative connection between risk and capital. Tan & Floros (2013) found a converse connection between capital and risk.

Comparable outcomes are provided by Maji & Hazarika (2016) in their investigations. Awdeh et al. (2011) uncovered in their investigation that there is a positive connection between bank capital and risk. Alkadamani (2015) investigated the association between risk and capital by taking the example from the Middle East and finished a positive relationship. Ugwuanyi (2015) analyzed the connection between risk and capital in the post-emergency setting and concluded positive association. Although a positive and negative relationship between bank capital and risk was observed by many studies, other studies found no relationship. Van Roy (2008) conducts a study in G-10 economies and found an insignificant association. Similar results are reported by Heid et al. (2003) and Maraghni & Bouheni (2015). Rime (2001) conducted a study in Swiss banking and found an insignificant relation between risk and capital. Montgomery (2005) opines in their study that banks change their portfolio into fewer risk assets. It concluded that the capital ratio has no effect on the Japanese banks' assets portfolio. Abbas, Iqbal, & Aziz (2019) examine the impact of bank capital ratios on bank risk-taking and conclude that an increase in capital buffer decreases US larger banks' portfolio risk. Ding & Sickles (2018) recently explore that there is a pos-

itive relationship between risk-taking and bank capital ratios. On the contrary Bitar et al. (2018) concludes an inverse relationship between bank capital ratios and bank risk-taking proxies.

3 Data and Methodology

3.1 Data

In the information structure of the current investigation, FDIC utilized the Federal Deposit Insurance Corporation (FDIC) institutional index for separating itemized data about the financial framework necessary to dissect the information over the long haul as indicated by the reports of FFIEC call/TFR, which is refreshed on a quarterly premise. The yearly data set accommodated financial institutions and spreads the extensive stretch of the flow research concentrated somewhere in the range of 2002 and 2018. The reason to study the large commercial of the USA is due to their significant business in banking industry of the world. The USA is the world most documented and integrated financial system. However, we only included the banks that are insured from the FDIC to keep the analysis more appropriate for our findings.

The test of the current examination study is adjusted to proportional board information containing insured commercial banks of the USA, as depicted in the reports of FDIC. Further, the advantages are additionally dependent on a united topic. There were numerous banks, almost 1806 in the referenced list on 31 December 2018, which was recorded by FDIC. However, for appropriate and reliable data analysis, the inclusion of the study sample units was based on the criteria that the listed banks should have been active on the reported date.There must not be any missing observations for any specific study variables of at least two years in the studied period.The total assets of banks must be greater than $300 million on the 31st December, 2018. After filtration of properly used criteria, there were 902 banks selected for the study sample size. The detail of proxies are enlisted in the table:

3.2 Econometric Model

The dynamic model is applied in this study.There are several reasons for applying GMM. Significantly, GMM controls the endogeneity of the lagged reliant variable in a dynamic setting. The endogeneity problem means that there is a connection between independent variables and the error term. GMM controls the measurement error problem, reduces omitted bias issue and controls the unobserved heterogeneity problem in panels. The means of the dynamic panel regression models have p lags of the dependent variable and comprise unobserved panel effects, which may be fixed or random. The correlation between unknown panel effects and the lagged value of dependent variables makes the estimators inconsistent.

Arellano & Bond (1991) provide a method called the generalized method of moments as the solution to make the estimators consistent. They argue that the use of a one-step and two-step approach in a large instrument matrix and robust standard errors for a one-step GMM approach are to be found seriously biased. To overcome this serious biasedness, Windmeijer (2005) presented a robust estimator for the two-step GMM approach, which is more efficient and is a biased-free method to calculate estimators. Later, Blundell & Bond

Table 1: Definitions and Measurement of Variables

Variable Name	Measurement
Bank Risk (TR)	Risk-Weighted Assets/Total Assets
Total Capital Ratio (TCAPR)	Total Equity to Total Assets (Abbas & Masood, 2020; Lee & Hsieh, 2013)
Risk-Based Capital Ratio (TRBCR)	Tier I Plus Tier II to Risk-Weighted Assets (Guidara et al., 2013)
Capital Buffer (BTRBC)	Actual Capital Ratio less than 8% (Abbas et al., 2020; Guidara et al., 2013)
Profitability (ROA)	Net Income to Total Assets (Yousaf et al., 2019)
Liquidity Ratio (LIQ)	Liquid assets to total assets (Yousaf et al., 2019, 2018)
Loan Ratio (LR)	Loans to Total Assets (Abbas, Iqbal, & Aziz, 2019)
Bank Size	Natural Log of Total Assets (Ali et al., 2019; Lee & Hsieh, 2013)
Market Power (MP)	Total Bank Deposit/Total Industry Deposit
Bank Efficiency (BE)	Cost/Revenue
Income Diversity (INDIV)	Non-Interest Income/Total Assets
Trade Freedom Index	Index is taken from the Heritage foundation (Abbas & Ali, 2020)
Inflation Rate (CPI)	Annual change in Consumer Price Index (Lee & Hsieh, 2013)
During-Crisis Dummy (DC)	1 for 2007 to 2009 otherwise 0
Before-Crisis Dummy (BC)	1 for 2002 to 2006 otherwise 0
After-Crisis Dummy (AC)	1 for 2010 to 2018 otherwise 0

(1998) worked on it further, and their findings have been used by various studies in the field of banking (Abbas, Butt, et al., 2019; Abbas, Iqbal, & Aziz, 2019; Fiordelisi et al., 2011; Lee & Hsieh, 2013; Tan, 2016). There are various simulations to run GMM like difference GMM, system GMM, where the difference and system GMM is further classified into one-step GMM and two-step GMM set. Each set has its own features and cons. Significantly, we use the two-step system GMM in this study. The two-step system GMM is more efficient than the one-step system GMM and two-step system GMM can capture the maximum values to calculate the estimators.

3.2.1 System GMM Model Specifications

The basic model of the system GMM approach is the following form:

$$\ln Y_{i,t} = \phi Y_{i,t-1} + \beta X'_{i,t-1} + (\eta + \varepsilon_{i,t}) \quad (1)$$

It is assumed that the above specification is a random walk equation and the dependent variables are persistent. Accordingly, the results of difference GMM produce an inefficient and biased parameter, particularly in finite samples.This means that the time span remains

limited and cross-sections contain long numbers. The empirical literature explains that the above bias and poor performance of difference GMM are due to poor instruments Blundell & Bond (1998). To deal with the above problem, the system GMM is used. The system GMM uses one equation in levels form with the first differences as instruments whereas the second equation is used in the first differences form with levels as instruments. The system GMM approach implicates a greater number of instruments, but Monte Carlo evidence recommends that where the period is limited and the dependent variable is found to be persistent, the use of system GMM reduce the bias of a small sample. There is another feature of system GMM; if there are autocorrelation and heteroscedasticity in the data, a two-step system GMM should be applied by developing a weighting matrix using residuals from the first step. It is also argued that in limited samples, the standard errors found to be downward biased. In this situation, researchers recommend applying the robust standard error approach developed by Windmeijer (2005), which corrects the sample bias.

3.2.2 Difference or System GMM to be Used

The basic model equation:

$$\ln Y_{i,t} = \phi Y_{i,t-1} + \beta X^{'}_{i,t-1} + (\eta + \varepsilon_{i,t})$$

What is better to apply for consistent and unbiased parameters? The rule of thumb provided by Bond et al. (2001) suggests the OLS is to be applied first and the LSDV method is used second to find out the estimators. The panel OLS estimator ϕ should be the upper-bound estimate, whereas the fixed effects estimator is considered a lower-bound estimator. The decision is taken on the basis of difference GMM estimates; if the estimates are close to or below the estimators of the fixed effects method, the former estimators are considered to be downward biased due to the weak instruments, and system GMM is to be preferred as the best choice to apply instead of difference GMM.

The following model is used in this study under the condition elaborated above:

$$Y_{i,t} = \alpha + Y_{i,t-1} + \beta_1 X_{i,t} + \beta_2 Z_{i,t} + \varepsilon \tag{2}$$

Here the Y is a dependent variable which is risk in this study i, represents banks and t shows time period, t-1 is lagged value of risk. β unknown parameters X is the independent variable, which is capital in this case where it may be total capital ratio, total risk-based capital ratio and capital buffer ratio based on the simulation under observation. Z shows the list of control variables and ε is an error term.

The following model is also used by adding time dummies to find out the results of the pre, during and post-crisis period where needed. The standard form of equations when time dummies are added is as follows:

$$Y_{i,t} = \alpha + Y_{i,t-1} + \beta_1 X_{i,t} + \beta_2 Z_{i,t} + \beta_3 PeriodDummies + \varepsilon \tag{3}$$

In the above model period, dummies include pre, during and post-crisis periods. This equation provides the results of the variations of concern variables by comparing different time periods.

4 Results and Discussion

4.1 Overall Sample Results for Large Insured Commercial Banks

Table 2 reports the results of the general sample. To save space, the engaging examination and relationships grid is given in the reference section. The information contains in the correlation matrix is suitable for analysis. Notwithstanding, when the hazard is measured as risk-weighted assets, the effect of capital positively influences bank risk-taking. These outcomes are reliable with the past investigations (Aggarwal & Jacques, 1998; Altunbas et al., 2007; Jokipii & Milne, 2011; Shrieves & Dahl, 1992). The coefficient on the slacked risk in the model extents about 0.394 and is positive, which demonstrates that one reason for the expansion in the current risk is the already overarching hazard as found by Aggarwal & Jacques (1998). In any case, the positive indication of the slacked hazard is repudiating the discoveries of Aggarwal & Jacques (1998) and Shrieves & Dahl (1992). The discoveries show that the relationship between capital buffer ratio and risk-taking is critical and negative. The negative relationship is upheld by the ethical risk theory (Jacques & Nigro, 1997; Jokipii & Milne, 2011; Lee & Hsieh, 2013; Mongid et al., 2012; Zhang et al., 2008).

The effect of benefit is positive with hazard as closed by Aggarwal & Jacques (1998). Strikingly, the risk-based capital proportion and bank hazard have a positive relationship. This perception seems to support the theory that banks with a more noteworthy extent of risk-based capital would have lesser odds of default. Therefore, by keeping up a higher extent of risk-based capital against unsafe resources, commercial banks can keep the likelihood of default lower. The discoveries are in-accordance with Shim (2010). The coefficient of liquidity proportion is negative, which implies that an expansion in the liquidity of banks lead decreases the risk in the short run, different things held comparative. The positive and measurably critical coefficient of advance proportion implies that the exorbitant loaning of banks increases risk.

Table 2: Overall Sample Results (Capital and Risk)

Variables	Bank-Risk	Bank-Risk	Bank-Risk
L. Bank-Risk	0.394***	0.371***	-0.509
	-0.058	-0.057	-0.44
Total capital ratio	0.925**		
	-0.418		
Risk-based capital ratio		0.536*	
		-0.324	
Capital buffer ratio			-6.013**
			-2.934
Profitability	0.869*	0.724	-13.57**
	-0.495	-0.574	-6.715
Liquidity ratio	-0.499***	-0.533***	-0.216
	-0.061	-0.065	-0.206
Loan ratio	0.662***	0.713***	0.401***
	-0.02	-0.0274	-0.134
Bank size	-0.006	-0.002	-0.073**
	-0.005	-0.006	-0.034
Market power	-0.001	-0.015	0.029
	-0.043	-0.046	-0.087
Bank efficiency	0.001	0.004	-0.006*
	0	0	-0.003
Income diversity	0.006	-0.01	0.503**
	-0.037	-0.05	-0.24
Trade freedom	4.536	0.001	0.010**
	0	0	-0.004
Inflation rate	-0.004***	-0.003***	0.013*
	0	0	-0.007
Observations	13,483	13,498	13,498
Banks	900	901	901
No. of Instruments	15	15	15
AR(2)	0.171	0.166	0.051
Hansen Test Statistics	0.078	0.064	0.837

* *** p<0.01, ** p<0.05, * p<0.1

4.2 During, Before, and Post-Crisis Period

Table 3 shows the results of pre, pro and after-crisis periods. The lagged coefficient of bank risk is found to be positive and statistically significant to influence the current risk. The positive sign indicates that the previous risk remains part of the current risk.The positive sign of the lagged risk is contradicting with Aggarwal & Jacques (1998) and Shrieves & Dahl (1992). The results show that bank capital ratios' influence is not similar in pre, pro and after-crisis period. The relationship between the bank capital ratio and bank risk ratio is statistically significant and positive. The results show that the intensity of banks' risk-taking due to the increase in the total capital ratio was greater before the crisis as compared with during and before-crisis periods. The proportionate change risk against capital ratio is lower during and in the after-crisis period, which indicates the effect of regulators' rec-

ommendations. The positive relationship is supported by the regulatory theory (Aggarwal & Jacques, 1998; Altunbas et al., 2007; Jokipii & Milne, 2011; Shrieves & Dahl, 1992). The findings reveal that the relationship between the total risk-based capital ratio and bank risk is negative and significant. The results are favoring the regulators' suggestion for a higher amount of capital to decrease risk.

The coefficients of the risk-based capital ratio show that the influence is more pronounced in the post-crisis period as compared with the pre-crisis period. However, the impact remains more significant during the crisis than the pre-crisis period. The findings reveal that the connection between the capital buffer ratio and risk is negative and significant. The negative relationship is supported by the moral hazard theory (Jacques & Nigro, 1997; Lee & Hsieh, 2013; Zhang et al., 2008). The role of profitability, liquidity, income diversification and loan ratio and trade freedom have an economic significance for readers. The profitability and liquidity remain key determinants to decrease the risk of large insured commercial banks during crisis, which supports the holding of higher liquidity. The results show that the loan ratio is a cause to increase risk. It is observed that more diversified banks take greater risk during-crisis period. The impact of trade freedom also encourages banks manager to take a greater risk.

Table 3: During-Crisis, Before-Crisis, and Post-Crisis Period Results

Variables	**Bank-Risk**	**Bank-Risk**	**Bank-Risk**
L. Bank-Risk	0.275***	0.188***	0.218***
	-0.05	-0.047	-0.032
Total capital ratio	0.517***		
	-0.13		
Total capital ratio*DC	-0.240**		
	-0.102		
Total capital ratio*AC	-0.272**		
	-0.121		
Risk-based capital ratio		-0.437***	
		-0.099	
Risk-based capital ratio*DC		-0.234***	
		-0.07	
Risk-based capital ratio*AC		-0.246***	
		-0.082	
Capital buffer ratio			-0.383***
			-0.14
Capital buffer ratio*DC			-0.306***
			-0.106
Capital buffer ratio*AC			-0.276**
			-0.124
Profitability	-0.601	-1.950***	-0.969***
	-0.574	-0.561	-0.309
Liquidity ratio	-0.496***	-0.456***	-0.447***
	-0.06	-0.061	-0.059
Loan ratio	0.675***	0.644***	0.653***
	-0.017	-0.018	-0.017
Bank size	-0.014**	-0.021***	-0.009*
	-0.006	-0.006	-0.005
Market power	0.024	0.014	-0.025
	-0.046	-0.049	-0.051
Bank efficiency	0.001	0.001*	0.001
	0	0	0
Income diversity	0.125**	0.246***	0.127***
	-0.052	-0.048	-0.037
Trade Freedom	0.005**	0.007***	0.004***
	-0.002	-0.002	-0.001
Inflation rate	-0.001	0.001	-0.001
	-0.001	-0.001	0
Observations	13,483	13,498	13,498
Banks	900	901	901
No. of Instruments	14	15	17
AR(2)	0.117	0.074	0.128
Hansen Test Statistics	0.056	0.091	0.003

4.3 Well, Adequately and Under-Capitalized Banks Results

Table 4 shows the aftereffects of all-around promoted protected business banks. The slacked intermediary of risk is found to affect the current risk. The positive indication of slacked risk is negating the literature (Aggarwal & Jacques, 1998; Shrieves & Dahl, 1992). The results show that total capital, risk-based capital and capital buffer ratio are found inconsequential to even consider influencing the all-around promoted bank hazard taking (Shrieves & Dahl, 1992). These outcomes demonstrate that very much promoted banks are not bound to assemble their capital with an expansion in their risk because of lower limitations and relax checking. The outcomes are more esteemed for controllers to evaluate the conduct of well-capitalized banks to expand their capital and risk while watching the genuine story of risk-taking and the capital ratio.

Table 4: Well Capitalized Banks Results

Variables	**Bank-Risk**	**Bank-Risk**	**Bank-Risk**
L. Bank-Risk	0.653**	0.513**	0.501***
	-0.284	-0.217	-0.19
Total capital ratio	1.942		
	-1.474		
Profitability	0.28	-0.408	-0.684
	-1.986	-1.707	-1.594
Liquidity ratio	-0.573**	-0.650***	-0.642***
	-0.272	-0.24	-0.241
Loan ratio	0.589***	0.628***	0.618***
	-0.07	-0.06	-0.057
Bank Size	-0.024	-0.026	-0.027
	-0.018	-0.02	-0.02
Market power	0.18	-0.005	-0.094
	-0.554	-0.529	-0.529
Bank efficiency	0.001	-0.001	-0.001
	-0.002	-0.001	-0.001
Income diversity	0.112	0.0643	0.118
	-0.166	-0.148	-0.161
Trade freedom	0.003**	0.003**	0.004**
	-0.001	-0.001	-0.001
Inflation rate	1.675	0.001	0.002
	-0.002	-0.002	-0.003
Risk-based capital ratio		0.742	
		-0.827	
Capital buffer ratio			0.891
			-0.881
Observations	2,110	2,125	2,125
Banks	141	142	142
No. of Instruments	12	12	12
AR(2)	0.051	0.171	0.133
Hansen Test Statistics	0.827	0.262	0.293

4.4 Adequately Capitalized Banks Results

Table 5 exhibits the presence of adequately capitalized banks on the association between risk and capital proportions. The outcomes propose that the general capital degree of adequetely capitalized banks might not affect bank hazard taking that is viable with Shrieves & Dahl (1992). The discoveries exhibit that the connection between the general risk-based capital proportion, the capital buffer proportion and the risk is negative. The outcomes recommend that the rise in the risk-based capital proportion and the capital cradle proportion adds to a fall in the probability of adequately promoted secured business banks. The negative affiliation between capital and risk proportions is affirmed by Jacques & Nigro (1997), Lee & Hsieh (2013) and Zhang et al. (2008).

Table 5: Adequately Capitalized Banks Results

Variables	**Bank-Risk**	**Bank-Risk**	**Bank-Risk**
L. Bank-Risk	0.387***	0.201	0.176
	-0.136	-0.131	-0.135
Total capital ratio	0.313		
	-0.937		
Profitability	0.461	-4.075*	-3.872*
	-2.408	-2.086	-1.966
Liquidity ratio	-0.582***	-0.457**	-0.466**
	-0.218	-0.196	-0.195
Loan ratio	0.667***	0.611***	0.616***
	-0.045	-0.048	-0.045
Bank size	0.011	-0.019	-0.015
	-0.016	-0.016	-0.014
Market power	-0.813**	-0.861***	-0.869***
	-0.344	-0.322	-0.308
Bank efficiency	0.002	0.001	0.002
	-0.002	-0.001	-0.001
Income diversity	0.00814	0.311**	0.271**
	-0.141	-0.132	-0.118
Trade freedom	-0.004	0.002	0.001
	-0.001	-0.001	-0.001
Inflation rate	-0.003	-0.001	-0.001
	-0.002	-0.002	-0.002
Risk-based capital ratio		-0.949*	
		-0.532	
Capital buffer ratio			-1.157*
			-0.606
Observations	1,525	1,525	1,525
Banks	102	102	102
No. of Instruments	15	12	12
AR(2)	0.931	0.876	0.992
Hansen Test Statistics	0.398	0.19	0.222

4.5 Under-Capitalized Banks Results

The consequences of table 6 highlight the perceptions of under-capitalized banks. The discoveries indicate that the coefficient of slacked likelihood is positive and significant at a trust level of 10%. The hopeful indication of slacked peril is conversely with Aggarwal & Jacques (1998) and Shrieves & Dahl (1992). The outcomes show that there is no relationship between the risk and capital proportions of under-capitalized banks. These discoveries are unexpected, yet they are viable with the past examination. In a portion of the conditions, Shrieves & Dahl (1992) have thought about immaterial capital coefficients to impact threat.

Table 6: Under-Capitalized Banks Results

Variables	**Bank-Risk**	**Bank-Risk**	**Bank-Risk**
L. Bank-Risk	0.180*	0.226*	0.232**
	-0.095	-0.131	-0.116
Total capital ratio	-0.352		
	-0.425		
Profitability	-0.086	0.571	0.828
	-1.268	-1.354	-1.037
Liquidity ratio	-0.510***	-0.471***	-0.481***
	-0.105	-0.118	-0.116
Loan ratio	0.709***	0.650***	0.659***
	-0.036	-0.051	-0.041
Bank size	0.013	0.022**	0.022**
	-0.021	-0.01	-0.01
Market power	-0.144	-0.316	-0.293
	-0.472	-0.445	-0.376
Bank efficiency	-0.001	-0.026	-0.006
	0	0	0
Income diversity	-0.052	-0.02	-0.039
	-0.104	-0.06	-0.048
Trade freedom	-0.002	-0.004	-0.004
	-0.001	0	0
Inflation rate	-0.003**	-0.003*	-0.004**
	-0.001	-0.002	-0.001
Risk-based capital ratio		-0.482	
		-0.563	
Capital buffer ratio			-0.425
			-0.456
Observations	3,611	3,611	3,611
Banks	241	241	241
No. of Instruments	15	15	15
AR(2)	0.181	0.335	0.343
Hansen Test Statistics	0.549	0.497	0.477

Table 7 shows the results of essentially under-capitalized banks. The lagged threat coefficient is hopeful and significant at a 1% trust stage. This idealistic pointer of slacked threat recommends that the earlier peril prompts the current risk. The idealistic indication of

lagged hazard is conversely with Aggarwal & Jacques (1998) and Shrieves & Dahl (1992). The results demonstrate that the bank's capital proportion doesn't influence the bank's mischief. Shockingly, the partnership between hazard-based capital and bank hazard is both useful and important. These findings show that generously under-promoted banks are likewise neglecting to raise their profit by utilizing their restricted assets. The useful connection between capital and risk is underpinned (Aggarwal & Jacques, 1998; Shrieves & Dahl, 1992). As a result, they take more risks to draw on their usable benefit in their speculations. The outcomes propose that capital support and bank threat are negatively related (Jacques & Nigro, 1997; Lee & Hsieh, 2013; Zhang et al., 2008). This guarantees that under-promoted banks are required to create support to lessen their risk.

Table 7: Significantly Undercapitalized Banks Results

Variables	**Bank-Risk**	**Bank-Risk**	**Bank-Risk**
L. Bank-Risk	0.294***	0.644***	0.301***
	-0.053	-0.183	-0.068
Total capital ratio	0.309		
	-0.271		
Profitability	-2.117***	8.743	-3.338***
	-0.516	-5.479	-0.534
Liquidity ratio	-0.480***	-0.788***	-0.477***
	-0.047	-0.205	-0.056
Loan ratio	0.697***	1.035***	0.647***
	-0.018	-0.205	-0.019
Bank size	-0.029***	0.021	-0.035***
	-0.005	-0.027	-0.006
Market power	0.053**	0.008	0.070**
	-0.025	-0.054	-0.03
Bank efficiency	-0.002	0.002	0.001
	0	-0.001	0
Income diversity	0.177***	-0.535	0.371***
	-0.032	-0.353	-0.048
Trade freedom	0.002***	-0.006	0.003***
	0	-0.004	0
Inflation rate	-0.003	-0.013*	0.001
	-0.001	-0.007	-0.001
Risk-based capital ratio		5.558*	
		-3.149	
Capital buffer ratio			-0.857***
			-0.127
Observations	6,161	6,161	6,161
Banks	411	411	411
No. of Instruments	15	12	12
AR(2)	0.995	0.126	0.35
Hansen Test Statistics	0.142	0.625	0.011

4.6 Highly-Liquid and Low-Liquid Banks Results

Table 8 shows the consequences of high-fluid banks. The slacked likelihood is viewed as optimistic and significant at 1% trust level. The idealistic indication of slacked risk is interestingly with Aggarwal & Jacques (1998) and Shrieves & Dahl (1992). The discoveries demonstrate that the capital level isn't exactly enormous. The discoveries demonstrate that the connection between the risk based capital proportion and bank peril is negative and significant at a 10% degree of trust. The detrimental relationship is viable (Jacques & Nigro, 1997; Lee & Hsieh, 2013; Zhang et al., 2008). Opposite relationship infers an ascent in hazard-based capital that contributes to a decrease in general risk. The discoveries uncovered a converse relationship between bank weakness and capital support. The theory suggests that a higher volume of capital contributes to a decrease at serious risk.

Table 8: High Liquid Banks Results

Variables	**Bank-Risk**	**Bank-Risk**	**Bank-Risk**
L. Bank-Risk	0.188**	0.201***	0.204***
	-0.0887	-0.0712	-0.0695
Total capital ratio	-0.681		
	-0.558		
Risk-based capital ratio		-0.574*	
		-0.322	
Capital buffer ratio			-0.575*
			-0.308
Profitability	-1.533	-2.218*	-1.978*
	-1.092	-1.144	-1.034
Liquidity ratio	-0.610***	-0.597***	-0.597***
	-0.096	-0.094	-0.094
Loan ratio	0.672***	0.618***	0.626***
	-0.026	-0.032	-0.028
Bank size	0.003	-0.002	-0.001
	-0.012	-0.012	-0.011
Market power	-0.422	-0.329	-0.313
	-0.282	-0.265	-0.257
Bank efficiency	-0.001	-0.001	-0.001
	0	0	0
Income diversity	0.0876	0.153**	0.127**
	-0.0658	-0.0686	-0.062
Trade freedom	0.001	0.001	0.001
	0	0	0
Inflation rate	-0.003**	-0.002**	-0.003**
	-0.001	-0.001	-0.001
Observations	6,718	6,733	6,733
Banks	449	450	450
No. of Instruments	12	12	12
AR(2)	0.261	0.298	0.302
Hansen Test Statistics	0.488	0.644	0.636

4.7 Low Liquid Banks Results

The discoveries of low-liquid protected business banks as found in table 9. The outcomes recommend that the coefficient of slacked likelihood is idealistic and important at a 1% level of hugeness. The idealistic sign of slacked weakness repudiates the perceptions of Aggarwal & Jacques (1998) and Shrieves & Dahl (1992). The discoveries show that there is a solid and important relationship between the general capital level and the weakness of low-fluid insurance business banks. The positive connection among risk and assets is affirmed by the administrative hypothesis (Aggarwal & Jacques, 1998; Shrieves & Dahl, 1992). The discoveries are not similar to high-fluid safeguarded business banks, since low-fluid banks send the general capital proportion to improve their effectiveness, while highly liquid banks use hazard based capital levels to control their administrative requirements.

Table 9: Low Liquid Banks Results

Variables	**Bank-Risk**	**Bank-Risk**	**Bank-Risk**
L. Bank-Risk	0.454***	0.450***	0.469***
	-0.076	-0.079	-0.091
Total capital ratio	0.769**		
	-0.373		
Risk-based capital ratio		0.487	
		-0.32	
Capital buffer ratio			0.52
			-0.355
Profitability	0.378	0.48	1.119
	-0.429	-0.489	-0.705
Liquidity ratio	-0.429***	-0.464***	-0.481***
	-0.065	-0.087	-0.089
Loan ratio	0.695***	0.742***	0.730***
	-0.028	-0.028	-0.029
Bank size	-0.0185**	-0.0126	-0.009
	-0.008	-0.007	-0.008
Market power	0.021	0.014	0.02
	-0.045	-0.052	-0.052
Bank efficiency	0.001	0.001	0.001*
	0	0	0
Income diversity	0.0201	0.0102	-0.0197
	-0.025	-0.026	-0.041
Trade freedom	0.001**	0.001**	0.0016**
	0	0	0
Inflation rate	-0.002*	-0.001	-0.001
	-0.001	-0.001	-0.001
Observations	6,765	6,765	6,765
Banks	451	451	451
No. of Instruments	18	18	15
AR(2)	0.282	0.251	0.294
Hansen Test Statistics	0.108	0.137	0.112

5 Conclusion

The outcomes are more noteworthy for controllers to watch the conduct of risk-taking and adjustment of bank capital of banks in the post-crisis with comparison of pre and pro-crisis periods. The bits of knowledge of well, adequately, under, significantly undercapitalized, high, and low liquid enhances the controllers for the formulation of proper rules. The outcomes show that the capital proportion and bank portfolio hazard proportion move a similar way according to the hypothesis of administrative theory. Interestingly, in the full sample, the connection between the risk-based capital proportion and bank portfolio hazard is positive. This perception seems to support the speculation that safeguarded commercial saves money with a more noteworthy extent of risk-based capital would have lesser odds of default.

Consequently, by keeping up a higher extent of risk-based capital against risk assets, banks can keep the likelihood of default lower. The impact of bank capital proportions is not comparative in pre, pro and post-crisis period. The outcomes show that the power of banks' risk-taking because of the expansion in the total capital proportion was greater in pre-crisis as contrasted to the pro and post-crisis periods. The proportionate change in portfolio hazard against the adjustment in capital proportion is lower in pro post-crisis period, which underpins the controllers' proposals. The coefficients of the risk-based capital proportion show that the impact is more articulated in the post-emergency period as analyzed with the before-emergency period. Notwithstanding, the effect stays more noteworthy during the crisis than pre-crisis period.

The adequately and well-capitalized banks undoubtedly assemble their all-out capital proportion with the increment in their risk because of lower limitations and loosen up observing. The outcomes are more esteemed for controllers to survey the conduct of very much promoted banks to build their capital and risk while watching the genuine story of risk-taking and the capital proportion of well-capitalized banks. The expansion in hazard-based capital proportion and capital cushion proportion of adequately promoted banks diminishes the risk. There is no association among hazard and the total capital proportion of under and altogether under-promoted banks. These outcomes are surprising however, predictable with past examinations. Because of fundamentally under-promoted banks, an expansion in the capital against hazard-weighted assets diminishes hazard.

The exceptionally liquid banks' hazard-based capital proportion and capital buffer proportion decrease hazard, while the total capital proportion has no impact on the risk of liquid banks. The conduct of low-liquid banks is not like liquid banks. The low-liquid banks increment their absolute capital proportion with the expansion of risk. The outcomes have suggestions for controllers to figure risk alleviation approaches as indicated by the necessity of banks.

5.1 Implications of the Study

The findings of the study have practical implications for concerned stakeholders. It is suggested that banks managers must manage their banks' capital buffer and risk-based capital level to keep their risk at a lower level for unexpected situations. It is also suggested that regulators should not only focus on building bank capital for the stability of commercial banks overall but also consider the types and categories of banks based on their capitalization and liquidity. The heterogeneity in findings of well-capitalized, adequately-

capitalized, under-capitalized, high liquid and low liquid banks has implications for policymakers in commercial banking to improve the stability of the financial system. The heterogeneity in findings of pre, pro and post-crisis periods also have implications for policymakers and regulators for the better solutions of commercial banks in future.

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