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Economics of capital adjustment in the US commercial banks: empirical analysis

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ABSTRACT

Using GMM framework on the data of the US commercial banks spanning over 2002 to 2018, this study shows that banks adjust their regulatory capital ratios faster than traditional capital ratios. Our results show that the speed of adjustment of regulatory capital ratios and traditional capital ratios increases in bank capital adequacy and bank liquidity, respectively. We also find that the speed of adjustment of regulatory capital ratios of too-big-to-fail banks is lower than well-capitalized, adequately-capitalized, nationally-chartered, and state-chartered banks. In addition, the speed of adjustment of regulatory capital ratios of commercial banks is higher in the post-crisis period than the pre-crisis era. Although scholars suggest that adjustment of capital ratios through rebalancing liabilities is more beneficial to the banks, our findings show that banks also use their assets side of balance sheet to rebalance their capital ratios.

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Capital ratio; regulatory ratio; tier-I ratio; speed of capital adjustment; bank charters

1. Introduction

The global financial crisis (GFC) in 2008 exposed the weakness of the global banking system and highlighted the importance of risk-weighted capital reserves and capital buffers to deal with market risk and sustain during the economic turmoil. The causes and effects of GFC also called for a robust and stable banking system to deal with unexpected financial and economic turmoil. Therefore, many studies have explored the relationship between risk-taking and capital ratios (Balla & Rose, 2019; Bitar, Pukthuanthong, & Walker, 2018; Brandao-Marques, Correa, & Sapriza, 2018; Ding & Sickles, 2018, 2019) of the banks. However, one aspect that is still lacking in the banking literature is how banks adjust their required capital ratios after an economic crunch. In addition, the speed of adjustment to attain their equilibrium capital and the factors significantly contributing to the process of capital adjustment in the banking sector are also key issues that attracted researchers' attention. Although recent studies (Abbas & Masood, 2020a, 2020b; Bakkar, De Jonghe, & Tarazi, 2019; De Jonghe & Öztekin, 2015) explored the process of capital adjustment for banks, the evidence on these issues is scarce and inconclusive. In particular, the questions about the speed of capital adjustment

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to restore commercial banks' equilibrium capital ratios, and the factors influencing the speed of capital adjustment are the major question marks for regulators, policymakers, and bank managers. This study attempts to address these voids in the existing literature and answers the questions for instance (1) does speed of capital adjustment vary across different types of capital ratios; (2) how does speed of capital adjustment vary across different levels of the factors, for instance, banks' capital adequacy, liquidity, charters, and economic conditions; (3) and do banks use assets or liability side of the balance sheet to adjust their capital ratios?

The study uses GMM framework on the data of the US commercial banks over the period from 2002 to 2018 to show that banks adjust their regulatory capital ratios faster than traditional capital ratios; and, in most cases, the speed of adjustment of a traditional capital ratio is lower than regulatory capital ratios. Our results document that the pace of regulatory capital ratio of well-capitalized banks is faster than adequately capitalized and under-capitalized banks. In addition, our analysis reports that high-liquid banks adjust their capital ratios faster than low-liquid banks. We also find that the speed of adjustment of regulatory capital of too-big-to-fail banks is lower than well-capitalized, adequately capitalized, nationally chartered, and state-chartered banks. Furthermore, the speed of adjustment of regulatory capital ratios of commercial banks is higher in the post-GFC period than in the pre-GFC era. Although scholars suggest that adjustment of capital ratios through rebalancing liabilities is more beneficial to the banks, our findings show that banks also use their asset side of the balance sheet to rebalance their capital ratios. Our findings suggest that the regulators may consider the heterogeneity in the speed of capital adjustment across different bank characteristics for the formulation of new bank regulations, particularly when assessing and adjusting the specific capital requirements through Pillar II of the Basel III agreement.

This study contributes to the existing literature in a few ways. First, the study provides an empirical evidence on the speed of capital adjustment using capital ratios, Tier-I ratios and regulatory ratios, where the work on Tier-1 ratios is new to the existing literature. Second, the study investigates banks' capital adequacy and liquidity as influencing factors in the capital adjustment process and speed of capital adjustment in the US commercial banks. Third, the study examines the influence of chartering authorities on the adjustment of capital ratios, which has never been discussed in existing literature. Fourth, the study provides empirical evidence on the speed of adjustment for too-big-to-fail US banks. Fifth, the study investigates the role of GFC in the adjustment process of bank capital ratios and captures the differential effects between pre- and post-GFC periods. Sixth, this study contributes to the body of existing knowledge by examining whether the adjustment process takes place through rebalancing more of assets or liability sides of the bank's balance sheets. Finally, the findings have valuable implications for regulators to devise new regulations for adjusting capital ratios. For instance, the findings of the study suggest that the regulators may consider the heterogeneity in the speeds of capital adjustment of banks with varying capital adequacy, liquidity, and charters for the formulation of new regulations, particularly when assessing and adjusting the specific capital requirements through Pillar II of the Basel III agreement.

The rest of the paper follows as: Section 2 discusses the literature review and develops the hypotheses. Section 3 presents our research design and methodology used in this

study. The discussion on the analysis has been reported in Section 4 and finally, Section 5 submits the conclusion, policy implications, and study limitations.

2. Literature review and hypotheses

Theoretical research on bank capital has primarily focused on the existence and determinants of optimal bank capital ratios (Diamond & Rajan, 2000; Myers & Rajan, 1998; Orgler & Taggart, 1983). An increasing body of empirical research also provides support for the existence of an optimal capital structure (Flannery & Rangan, 2008; Marcus, 1983; Schaeck & Cihak, 2012). Shrieves and Dahl (1992) use a partial adjustment regression model on annual data of 1800 FDIC insured independent and holding companies affiliated with commercial banks from 1983 to 1978 to document that the US banks strive to maintain a certain capital buffer above the regulatory requirements. The findings of Stolz, Heid, and Porath (2004) and, Kleff and Weber (2008) for German banks are also consistent with that of (Shrieves & Dahl, 1992). Using quarterly data of German banks, Merkl and Stolz (2006) show that the capital buffers influence banks' sensitivity to a contractionary monetary policy. Banks with low capital buffers shrink their lending more strongly than banks with large capital buffers.

Jokipii and Milne (2008) investigate the yearly data of European banks to estimate capital adjustment speeds and find that banks close two-third of their annual gap between the current and the target capital ratio. Their results also show that the capital adjustment speed of banks is significantly higher than that of non-financial firms. Bakkar et al. (2019) conclude that banks in OECD countries adjust their capital ratios faster than the regulatory capital ratios. Despite the existence of a reasonable amount of literature on capital adjustments, studies comparing the speed of capital adjustment of regulatory capital ratios with traditional capital ratios of the US banks are rare. Since the US banking sector is the originator and affectee of the global financial crisis, it is important to study how fast they adjust their capital ratios after the GFC to the level before the GFC; and, whether the speed of adjustment varies between regulatory capital ratios and traditional capital ratios. Based on these observations, our first hypothesis follows as:

H_{01}: The US banks adjust their regulatory capital ratios faster than traditional capital ratios.

The studies on banks' capital adjustment show that banks' speed of capital adjustment varies with the level of capital adequacy of banks. For instance, using a sample of US commercial banks over two periods (1984–1987) and (1993–1997), Aggarwal and Jacques (2001) find that under-capitalized banks increase their target capital ratio quicker than well-capitalized banks. However, Abbas and Masood (2020a) document that well-capitalized banks require lower time to achieve their target capital ratios than adequately capitalized banks. Jokipii and Milne (2011) find a two-way positive relationship between capital and risk in a sample of US banks where the capital adjustment depends on the degree of banks' capitalization. Hasnaoui and Fatnassi (2019) report a similar relationship in GCC countries over a period from 2003 to 2011. While studying the Lebanese banking sector, El-Khoury (2019) finds that under-capitalized banks increase their capital faster than well-capitalized banks and their behavior is driven by regulatory

pressure. Memmel and Raupach (2010) conclude that large banks create less liquidity in the market, but they do not react to credit loss. Abbas and Masood (2020a, 2020b) found that banks' performance and capital adjustment vary on the basis of their liquidity position. Our findings indicate that low-liquid banks require higher time than high-liquid banks to restore their equilibrium capital ratios. The existing studies about the speed of capital adjustment for different levels of banks' capital adequacy are inconclusive. In addition, studies about the speed of capital adjustment for different levels of banks' liquidity are scarce. These observations lead us to develop the following hypotheses:

H_{02}:: Speed of adjustment of regulatory and non-regulatory ratio varies with level of capital adequacy.

H_{03}:: Speed of adjustment of regulatory and non-regulatory ratio varies with banks' liquidity position.

The US banks can have three types of charters, which are nationally chartered banks (NAT), state-chartered member banks (SMB), and state-chartered non-member banks (SNM). The nature and controlling authorities of nationally and state-chartered banks are not similar. For example, nationally chartered banks can open their branches in any state in the US, whereas the state-chartered banks restrict their operations within the state. The nationally chartered banks are bound to buy the securities of Fed, while state charter banks are not. These charter differences do not affect only the bank operations but also the asset and liability mix in the balance sheets of the US banks. Consequently, the speed of capital adjustment could be different across the US banks with different charters. To explore whether this is the case, we formulate the following hypothesis:

H_{04}:: The speed of adjustment of capital ratios is not same across the US banks with different charters.

Existing literature also investigates the adjustments in banks' capital ratios due to regulatory and other factors. For instance, Ediz, Michael, and Perraudin (1998) use panel regressions on quarterly data of UK banks over the period from 1989 to 1995 to conclude that banks react to the regulatory pressure by adjusting their capital ratios primarily through capital rather than risk channel. Lepetit, Saghi-Zedek, and Tarazi (2015) studied banks of 17 European countries and found that in the absence of excess control rights, most of the European banks boost their capital ratios by equity without reducing lending. Huang and Ritter (2009) report that firms use external financing to adjust their capital ratios when the cost of the new issue remains low. They suggest a moderate pace with a half-life of 3.7 years for the capital ratios to achieve their targeted equilibrium ratios. Memmel and Raupach (2010) conclude large differences across financial entities. They argue that the use of the liability side for capital adjustment is more appropriate, whereas the tendency of capital adjustment is greater from the asset side. Öztekin and Flannery (2012) argue that financial traditions and legal laws significantly influence capital adjustment. They argue that larger organizations have lower transaction costs to adjust their leverage. De Jonghe and Öztekin (2015) argue that banks primarily use equity to adjust

their capital ratios instead of asset liquidation. They conclude that banks normally use earnings to extend their assets. They find that banks make quick adjustments in their capital ratios where the regulations are stringent. Following the above debate, we also test the following hypothesis:

H_{05}:: Commercial banks use their asset side of balance sheet to adjust their capital ratios

Some existing studies also explore the capital adjustments of the banks during the market downturn. For instance, using comprehensive data of 64 countries from 1994 to 2010, De Jonghe and Öztekin (2015) find that regulatory, supervisory, and economic conditions affect the speed of adjustment of the banks as different environments impose varying adjustments on costs and benefits of the firms. Cohen and Scatigna (2016) investigate the adjustment channel for capital ratios and find that the availability of a higher amount of capital makes banks' phase out the crises and earn greater profits by lending; and, banks adjust their capital more rapidly in a crisis period. Rubbaniy, Cheema, and Polyzos (2020) use the data of bank holding companies of the US to show that equity capital ratio and risk-based capital ratios respond differently to recessions and expansions. Bikker and Metzemakers (2004) analyze banks of 29 OECD countries to conclude a presence of little procyclicality in capital adjustments of the banks in these countries. Drobetz and Wanzenried (2006) argue that firm-specific and macroeconomic factors influence the adjustment of a firm's debt and capital ratio. They conclude that firms adjust their capital quickly during a good margin of profit and under good economic situations. Above discussion clearly concludes that the speed of capital adjustment is affected by market conditions; however, the results are contradictory and inconclusive which lead us to develop the following hypothesis:

H_{06}: The speed of capital adjustment of US banks in post-GFC period is faster than pre-GFC times.

3. Research design and methodology

3.1. The data

The data for this study span over the period from 2002 to 2018 and are collected from the two sources, i.e., WDI[1] and FDIC.[2] The data of our macroeconomic indicators come from WDI and data of the US bank-specific variables is extracted from FDIC. The choice of the time span is motivated by the reasons that it covers boom, GFC and post-GFC periods for the US banking industry. The choice of the US banks is motivated by the reliability of the data and its comparability with the existing studies. Since charter assumptions vary across different charters offered to the US banks, and these assumptions can affect the capital adjustments of the banks, our study takes all three charter classes into account, i.e., NAT, SNM and SMB. Our sample includes 1806 listed US banks; however, after excluding banks with missing values or having life less than

[1] https://data.worldbank.org/indicator
[2] https://www7.fdic.gov/idasp/advSearchLanding.asp

18 years, our final sample comprises of 1000 US commercial banks. To avoid any mismatch or dissimilarity bias, the data of all financial statements have been collected from the same source. We follow (Abbas & Masood, 2020b) to classify banks into well-capitalized, normal-capitalized and under-capitalized banks and categorize banks into high and low liquidity banks following Bitar et al. (2018).

3.2. Econometric model

Following the recent literature (Abbas & Masood, 2020b; Bakkar et al., 2019; De Jonghe & Öztekin, 2015), we develop our econometric model to study the partial adjustment process of bank's capital ratios that follows as:

$$Capitalratio_{i,t} = \gamma Capitalratio^{*}_{i,t} + (1-\gamma)Capitalratio_{i,t-1} + \varepsilon_{i,t} \tag{1}$$

Here $Capitalratio_{i,t}$ shows the capital ratio of bank i in time t; $Capitalratio^{*}_{i,t}$ indicates the target capital ratio of bank i in time t; $Capitalratio_{i,t-1}$ stands for the capital ratio of bank i in time *t-1*. Each year, a typical bank in the US closes a proportion γ of the gap between its actual and target capital levels. The smaller the value of γ, the more rigid the capital ratio is, and the longer time a bank requires to achieve its required capital ratio after a shock occurs in an economy. Thus, we can interpret γ as the speed of adjustment and its complement (1- γ) as the portion of capital that is inertial.

In Equation (1), bank's target capital ratio ($Capitalratio^{*}_{i,t}$) is unknown and varies both over time and cross-section. This target capital ratio is based on a linear trend of the lagged ratio of capital, characteristics of bank, and time-fixed factors. We follow the existing studies (Abbas & Masood, 2020a; Bakkar et al., 2019; De Jonghe & Öztekin, 2015) to capture these attributes in the following equation:

$$\begin{aligned} Capitalratio^{*}_{i,t} &= \alpha_0 + \beta_1 Capitalratio_{i,t-1} + \beta_2 \text{Profitability}_{i,t} + \\ &\beta_3 \text{Liquidity}_{i,t} + \beta_4 Loanratio_{i,t} + \beta_5 Size_{i,t} + \beta_6 Creditrisk_{i,t} + \beta_7 RWATA_{i,t} + \\ &\beta_8 Funding_{i,t} + \beta_9 Incomediversity_{i,t} + \beta_{10} Efficiency_{i,t} + \beta_{11} Economicgrowth_{i,t} + \\ &\nu_t + \mathrm{u}_i \end{aligned} \tag{2}$$

Here $Capitalratio^{*}_{i,t}$ shows the target capital ratio of bank i in time t; $Capitalratio_{i,t-1}$ stands for the capital ratio of bank i in time *t-1*. $\text{Profitability}_{i,t}$ is the ratio of net income to total assets of bank i in time t; $\text{Liquidity}_{i,t}$ is the ratio of liquid assets to total deposits of bank i in time t; $Loanratio_{i,t}$ is the ratio of net loans to total assets of bank i in time t; $Size_{i,t}$ is the natural logarithm of total assets of bank i in time t. $Creditrisk_{i,t}$ is the ratio of loan loss provisions to net loans of bank i in time t. $RWATA_{i,t}$ is the ratio of risk-weighted assets to total assets of bank i in time t. $Funding_{i,t}$ is the ratio of customer deposits to total funds of bank i in time t. $Incomediversity_{i,t}$ is the ratio of non-interest income to total income of bank i in time t. $Efficiency_{i,t}$ is the ratio of non-interest expenses to total income of bank i in time t. $Economicgrowth_{i,t}$ is the annual growth in gross domestic product of the country in time t. Our partial model of adjustment for capital ratios also includes factors of unobserved heterogeneity called time (ν_t) and panel-fixed effects $\mathrm{u_i}$. The panel-fixed effects of unobserved heterogeneity may be due to the efficiency of

management, risk behavior, economic conditions, financial and business freedom, and governance of banks. The inclusion of fixed effects in the capital adjustment model was supported by (Bakkar et al., 2019; Gropp & Heider, 2010; Huang & Ritter, 2009). From Equations (1) and (2) we get the following Equation (3):

$$\begin{aligned} Capitalratio_{i,t} = \gamma(\alpha_0 + \beta_1 Capitalratio_{i,t-1} + \beta_2 \text{Profitability}_{i,t} + \beta_3 \text{Liquidity}_{i,t} + \\ \beta_4 Loanratio_{i,t} + \beta_5 Size_{i,t} + \beta_6 Creditrisk_{i,t} + \beta_7 RWATA_{i,t} + \beta_8 Funding_{i,t} + \\ \beta_9 Incomediversity_{i,t} + \beta_{10} Efficiency_{i,t} + \beta_{11} Economicgrowth_{i,t} + \nu_t + u_i) + \\ (1-\gamma) Capitalratio_{i,t-1} + \varepsilon_{i,t} \end{aligned} \tag{3}$$

The presence of lagged value of the dependent variable in Equation (4) produces biased estimators in OLS-fixed effect framework. To control for the biasedness, we use GMM approach on Equation (4) as suggested by the existing literature (Abbas & Masood, 2020a, 2020b; Bakkar et al., 2019; De Jonghe & Öztekin, 2015).

The study also explores whether capital adjustment in the US banks takes place through the asset or liability side of the balance sheet. Banking literature documents that change in assets and liabilities of a bank are linked to its capital ratios through various channels. For example, an increase (decrease) in risk-weighted assets directly influences the bank's regulatory capital ratio and vice versa. To examine the effect of the balance sheet changes on adjusting bank capital ratios, we follow the recent literature (Abbas & Masood, 2020a, 2020b; Bakkar et al., 2019) to construct quartiles (Q1, Q2, Q3 & Q4) capital adequacy sorting. Here Q1 represents well-capitalized banks, Q2 and Q3 contain adequately capitalized banks and Q4 comprises of under-capitalized banks. After categorizing the banks, we use a mean-difference test to verify whether there are significant differences in the speeds of adjustment of well-capitalized, adequately capitalized and under-capitalized banks. Finally, we use a bootstrap method replicated at 500 to correct the estimated nature of the bank's expected capital ratio (Pagan, 1984).

The details of the variables and proxies used in this study are presented in Table 1.

4. Empirical analysis

4.1. Descriptive statistics

Our empirical investigation starts with the descriptive statistics of the variables of the study reported in Table 1, which shows that averages of capital ratio, Tier-I ratio, and regulatory ratio are 11.3%, 13.5%, and 15%, respectively. The risk-weighted asset ratio has a mean value of 67% with a standard deviation of 10.5%. The values of average and standard deviation of bank size are 13.335% and 9.33%, respectively. The profitability, liquidity, and loan growth average values are 10%, 33.7%, and 63.1%, respectively. The descriptive statistics of our study are generally inline with Bakkar et al. (2019) and Abbas and Masood (2020b).

Table 2 reports pair-wise correlations between the variables of our study. The correlation matrix in Table 2 shows no significantly higher pair-correlation between

Table 1. Descriptive statistics.

Variable	Measurement	Mean	Std. Dev.	Min	Max	Skewness	Kurtosis
Dependent Variable							
Capital ratio	Total Equity/Total Asset's ratio	0.113	0.019	0.065	0.165	0.881	2.995
Regulatory ratio	Tier I + II/Total Risk-weighted assets ratio	0.150	0.028	0.024	0.275	−0.094	3.947
Tier-I ratio	Tier I/Total Risk-weighted Assets' ratio	0.135	0.020	0.089	0.207	−0.678	2.641
Independent and control Variable							
Bank Size	Natural logarithm of banks total assets	13.555	0.933	12.259	15.538	0.771	3.008
Credit risk	Loan loss Provision/Net loan's ratio	0.008	0.003	0.002	0.020	−0.357	2.139
RWATA	Risk-weighted assets to total assets ratio	0.670	0.105	0.427	1.154	0.490	2.132
Bank Funding	Customer Deposits/Total funding ratio	0.555	0.011	0.532	0.589	0.672	2.180
Liquidity	Liquid assets/Total deposit ratio	0.337	0.113	−0.126	0.611	−0.139	2.350
Loan ratio	Net Loans/Total Assets' ratio	0.631	0.131	0.160	1.139	0.516	2.277
Income diversity	Non-interest income/Total income ratio	0.474	0.095	0.088	0.845	−1.919	6.944
Bank efficiency	Non-interest expenses/Total income ratio	2.983	1.759	−2.472	11.65	0.312	2.518
Profitability	Net income/Total assets ratio	0.010	0.005	−0.051	0.021	0.255	4.016
Economic Growth	The annual growth in gross domestic product	2.039	1.387	−2.500	3.800	−0.365	2.418

This table reports summary statistics for capital ratio measures and other selected variables over the period from 2002 to 2019. Mean and standard deviation refer to the cross-sectional average and standard deviation of the firms' time-series averages.

the variables suggesting no multicollinearity issue in modeling our variables in the study.

4.2. Does speed of adjustment vary across capital and regulatory ratios?

Table 3 reports the empirical results of our full sample analysis of the US commercial banks. Column 1 of Table 3 reports the full sample capital adjustment results for capital ratios, Column 2 reports results for regulatory ratios and Tier-I capital ratios results are posted in Column 3 of Table 3. From Columns 1 and 2 of Table 3 it is clear that the US banks adjust their regulatory ratio faster than the capital ratio, and thus support our statement in H_{01}. The full sample results indicate that the average speeds of adjustment (1- γ) for the capital ratios, regulatory ratios and Tier-I ratios are 27.5%, 49.9%, and 48.3%, respectively. Another informative metric, which provides economic meaning to the estimated parameters, is the half-life.[3] The half-life is defined as the amount of time required by banks to adjust half of the difference between their actual and target capital ratios. Our speeds of adjustments of capital ratios, regulatory ratios and Tier-I ratios correspond to the half-lives of 2.16, 1, and 1.05 years, respectively, which are consistent with (Abbas & Masood, 2020a, 2020b; Bakkar et al., 2019).

4.3. Does speed of capital adjustment vary across banks with different charters and too-big-to-fail banks?

Table 4 documents the results of Equation (3) for banks with different charters. Columns 1–3 contain the outcomes for NAT, Columns 4–5 for SNM, and Columns 6–9 for SMB.

[3] $\text{Half} - \text{life} = \frac{log(0.5)}{log(1-\text{Adjustmentspeed})}$.

Table 2. Pairwise correlation statistics.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Capital ratio	1												
Regulatory ratio	0.081*	1											
Tier-I ratio	0.033*	0.022*	1										
Bank Size	0.032*	−00.013*	−00.037*	1									
Credit risk	−00.04*	−0.104	−0.050)	0.012*	1								
RWATA	0.030*	−0.022*	−0.051*	0.067*	0.023*	1							
Funding	−0.021*	0.010*	−0.010*	0.016*	0.004*	0.004*	1						
Liquidity	0.037*	0.014*	0.015*	0.035	0.037*	0.034*	0.001*	1					
Loan ratio	0.036*	−0.002*	−0.004*	−0.003*	0.018*	0.012*	0.001*	0.002*	1				
Income diversity	0.022*	0.062*	0.034*	0.301*	−0.301*	−0.041*	0.005*	−0.002*	−0.012*	1			
Efficiency	−0.066*	−0.011*	−0.012*	−0.035*	0.108*	−0.029	0.008*	−0.023*	−0.013*	−0.210*	1		
Profitability	0.071*	0.061*	0.054*	−0.013*	−0.205*	0.058*	−0.017	0.035*	−0.012	0.071*	−0.023*	1	
Economic growth	0.011*	0.042*	0.052*	−0.022*	−0.300*	−0.031*	−0.001*	−0.001*	−0.011*	0.021*	−0.028*	0.061*	1

This table reports the pair-wise correlations for capital ratio measures and other selected variables over the period from 2002 to 2019. * represents the significance at 5%.

Table 3. Speed of adjustment across regulatory and non-regulatory capital ratios.

	Full Sample Results		
	(1)	(2)	(3)
VARIABLES	Capital ratio	Regulatory ratio	Tier-I ratio
Lag dep. variable	0.725***	0.502***	0.517***
	(0.026)	(0.035)	(0.007)
Profitability	−0.207***	−0.201***	−0.598***
	(0.055)	(0.108)	(0.110)
Liquidity	0.008***	0.002***	0.002***
	(0.001)	(0.00236)	(0.003)
Loan ratio	0.007***	0.004**	0.005***
	(0.000)	(0.000)	(0.000)
Bank Size	0.001	−0.003***	−0.002***
	(0.000)	(0.000)	(0.000)
Credit Risk	−0.214*	0.143	−0.263
	(0.101)	(0.101)	(0.301)
RWATA	0.004***	−0.063***	−0.052***
	(0.002)	(0.006)	(0.001)
Bank Funding	−0.002***	0.004***	−0.008***
	(0.001)	(0.001)	(0.001)
Income diversity	0.017**	0.052***	0.057***
	(0.005)	(0.005)	(0.015)
Bank Efficiency	0.001	−0.001	0.003
	(0.002)	(0.002)	(0.002)
Economic growth	0.003***	−0.005	0.008
	(0.000)	(0.000)	(0.000)
Constant	0.002	0.142***	0.102***
	(0.007)	(0.016)	(0.010)
Observations	17,000	17,000	17,000
Number of id	1000	1000	1000
Hansen Value	0.124	0.201	0.429
AR (2)	0.407	0.512	0.202

This table used two-step GMM method to measure the speed of adjustment by using three capital ratios. Capital ratio (Total Equity/Total Asset's ratio) results are presented in Column 1; regulatory ratio (Tier I + II/Total Risk-weighted assets ratio) results are disclosed in Column 2, and Tier-I ratio (Tier I/Total Risk-weighted Assets' ratio) results are reported in Column 3. Robust standard errors are reported in parentheses. ***, **,* represent statistical significance at 1%,5% and 10%, respectively.

As clear from Columns 1–9, the speeds of capital ratios (1- γ) to achieve equilibrium capital ratios are 32.9%, 16.6%, and 38.8% for NAT, SMB, and SNM, respectively. The adjustment speeds of regulatory ratios to reach the targets are 34.7%, 37.9%, 21.2% for NAT, SMB, SNM, respectively. In a nutshell, the speed of adjustment of a regulatory ratio is higher than the capital ratio, which agrees with the base model results. However, SBM adjusts its regulatory ratio faster than NAT.

Table 5 reports the results for too-big-to-fail banks and discloses that the speeds of adjustment for capital, regulatory and Tier-I capital ratios for too-big-to-fail banks are 27.1%, 28.3% and 22.4%, respectively. Overall, these findings show that banks generally focus more on their regulatory and capital ratio than the Tier-I ratio. One of the explanations for banks to not adjust their Tier-I ratio at a faster speed is due to the higher cost of raising funds and the adverse impact on the charter value of banks. The behavior of too-big-to-fail banks to adjust their capital ratios is more consistent than their other counterparts. The possible explanation for this consistency of too-big-to-fail banks is due to more stringent monitoring of regulators on a priority basis. The rate of

Table 4. Adjustment of capital ratios across commercial bank charters.

	Nationally Chartered Banks			State Chartered Member Banks			State Chartered non-member banks		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	Capital ratio	Regulatory ratio	Tier-I ratio	Capital ratio	Regulatory ratio	Tier-I ratio	Capital ratio	Regulatory ratio	Tier-I ratio
Lag dep. variable	0.671***	0.653***	0.878***	0.834***	0.621***	0.831***	0.612***	0.788***	0.754***
	(0.313)	(0.077)	(0.004)	(0.110)	(0.030)	(0.102)	(0.005)	(0.001)	(0.004)
Bank Size	−0.002**	0.004*	−0.032**	−0.001*	−0.006***	−0.003	0.002***	−0.007	−0.007
	(0.007)	(0.311)	(0.210)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)
Credit Risk	−0.602*	0.012***	0.001*	−0.102*	0.120**	−0.419	0.241*	0.660**	0.521*
	(0.207)	(0.000)	(0.001)	(0.401)	(0.063)	(0.031)	(0.074)	(0.064)	(0.004)
RWATA	0.022***	0.021*	−0.014	0.002*	−0.031***	−0.025**	−0.024**	−0.081***	−0.061***
	(0.000)	(0.003)	(0.007)	(0.010)	(0.005)	(0.012)	(0.010)	(0.010)	(0.018)
Bank Funding	−0.018***	−0.003**	−0.002*	−0.001*	−0.004*	−0.002*	−0.001*	−0.001	−0.005**
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.002)	(0.002)
Liquidity	0.004***	0.301	−0.011*	0.004	0.005*	0.004**	0.014***	0.032***	0.051**
	(0.001)	(0.042)	(0.003)	(0.002)	(0.000)	(0.000)	(0.003)	(0.004)	(0.000)
Loan ratio	0.003**	−0.013***	−0.003***	−0.002	0.003*	0.004***	0.003***	−0.002	−0.009
	(0.000)	(0.001)	(0.003)	(0.001)	(0.005)	(0.000)	(0.000)	(0.000)	(0.000)
Income diversity	0.043***	0.001***	−0.010*	0.012	0.007*	0.009*	−0.006*	−0.007	−0.005
	(0.020)	(0.000)	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)	(0.017)	(0.043)
Bank Efficiency	0.016***	0.005*	0.003	0.007*	−0.040	0.011	−0.006*	−0.012*	−0.015*
	(0.001)	(0.005)	(0.019)	(0.004)	(0.003)	(0.002)	(0.005)	(0.004)	(0.010)
Profitability	−.068***	−0.152*	0.003	0.081	−0.083**	−0.022	−0.042	−0.201**	−0.003**
	(0.091)	(0.010)	(0.003)	(0.001)	(0.011)	(0.045)	(0.002)	(0.005)	(0.020)
Economic growth	0.006**	−0.002	−0.001*	0.002	0.002	0.003*	−0.001*	−0.009**	−0.005*
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	−0.042	0.061	0.002*	−0.102	0.013***	0.005*	0.022**	0.075***	0.006***
	(0.005)	(0.005)	(0.004)	(0.001)	(0.023)	(0.051)	(0.002)	(0.004)	(0.003)
Observations	11,220	11,220	11,220	3553	3553	3553	2227	2227	2227
Number of id	660	660	660	209	209	209	131	131	131
Hansen Value	0.310	0.703	0.608	0.449	0.905	0.121	0.41	0.73	0.75
AR (2)	0.610	0.508	0.702	0.576	0.322	0.430	0.26	0.37	0.21

This table used two-step GMM method to measure the speeds of adjustment across bank charters by using three alternative capital ratios. Columns 1–3 report the results for Nationally chartered banks; Columns 4–6 report the results for state-chartered member banks; and, Columns 7–9 report the results for state non-chartered banks. Capital ratio (Total Equity/Total Asset's ratio) results are reported in Columns 1,4,7; regulatory ratio (Tier I + II/Total Risk-weighted assets ratio) results are exhibited in Columns 2,5,8; and Tier-I ratio (Tier I/Total Risk-weighted Assets' ratio) results are presented in Columns 3,6 and 9. Robust standard errors are reported in parentheses. ***, **, * represent statistical significance at 1%,5% and 10%, respectively.

Table 5. Adjustment of capital ratios for too-big-to-fail bank results.

	(1)	(2)	(3)
VARIABLES	Capital ratio	Regulatory ratio	Tier-I ratio
Lag dep. variable	0.729***	0.717***	0.776***
	(0.001)	(0.001)	(0.001)
Bank Size	−0.012**	0.014**	−0.050**
	(0.002)	(0.011)	(0.010)
Credit Risk	−0.222*	0.612***	0.701*
	(0.200)	(0.000)	(0.001)
RWATA	0.002***	0.071**	−0.009**
	(0.001)	(0.002)	(0.001)
Bank Funding	−0.012***	−0.001	−0.001*
	(0.000)	(0.001)	(0.000)
Liquidity	0.014***	0.311	−0.111**
	(0.001)	(0.002)	(0.002)
Loan ratio	0.002**	−0.004**	−0.002***
	(0.000)	(0.001)	(0.003)
Income diversity	0.003***	0.002***	−0.041*
	(0.010)	(0.000)	(0.001)
Bank Efficiency	0.011***	0.002**	0.001
	(0.001)	(0.005)	(0.019)
Profitability	−.008***	−0.102**	0.002*
	(0.010)	(0.000)	(0.002)
Economic growth	0.002**	−0.001*	−0.002*
	(0.000)	(0.001)	(0.000)
Constant	0.056	0.268***	0.059
	(0.020)	(0.059)	(0.051)
Observations	850	850	850
Number of id	50	50	50
Hansen Value	0.76	0.22	0.72
AR (2)	0.57	0.83	0.52

This table used two-step GMM method to measure the speed of adjustment for too-big-to-fail banks. The results for capital ratio (Total Equity/Total Asset's ratio), regulatory ratio (Tier I + II/ Total Risk-weighted assets ratio) and Tier-I ratio (Tier I/Total Risk-weighted Assets' ratio) are reported in Columns 1,2 and 3, respectively. Robust standard errors are reported in parentheses. ***, **, * represent statistical significance at 1%,5% and 10%, respectively.

change and time required to achieve equilibrium is consistent with (Abbas & Masood, 2020b; De Jonghe & Öztekin, 2015), but does not support our H_{02}.

4.4. Does capital adjustment vary across bank capital adequacy?

Table 6 exhibits the results of our analysis of capital adjustments for different levels of capital adequacy. Columns 1–3 of Table 6 contain the findings for well-capitalized banks, Columns 4–6 report the results for adequately capitalized banks and Columns 7–9 provide evidence for under-capitalized banks. As clear from Table 6, the paces of adjustment of capital ratios (1- γ) of well-capitalized, adequately capitalized, and under-capitalized banks are 28.9%, 19.9%, and 27%, respectively. The speeds of adjustment of regulatory ratios of well-capitalized, adequate-capitalized and under-capitalized banks are 31.2%, 30.5%, and 19.9%, respectively. While comparing both the capital and regulatory ratios, we find that the speed of adjustment (1- γ) of well-capitalized banks is higher than adequately and under-capitalized banks for all capital ratios. These findings support our H_{03} and show that under-capitalized banks require higher time to restore their target capital ratios than well-capitalized and adequately capitalized banks.

Table 6. Capital ratio adjustment across bank capitalization.

	Well-capitalized banks			Adequately capitalized banks			Undercapitalized banks		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	Capital ratio	Regulatory ratio	Tier-I ratio	Capital ratio	Regulatory ratio	Tier-I ratio	Capital ratio	Regulatory ratio	Tier-I ratio
Lag dep. variable	0.711***	0.688***	0.706***	0.801***	0.695***	0.721***	0.729***	0.801***	0.814***
	(0.002)	(0.011)	(0.057)	(0.113)	(0.001)	(0.102)	(0.035)	(0.101)	(0.104)
Bank Size	0.618	0.114	−0.021	−0.001	−0.004***	−0.004	0.001***	−0.001	−0.001
	(0.330)	(0.406)	(0.106)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)
Credit Risk	0.001	0.004	0.001	−0.112	0.524**	−0.334	0.212	0.446**	0.351
	(0.007)	(0.004)	(0.001)	(0.624)	(0.563)	(0.731)	(0.374)	(0.546)	(0.714)
RWATA	−0.028	0.081	−0.034	0.121*	−0.031***	−0.025**	−0.024**	−0.081***	−0.061***
	(0.148)	(0.133)	(0.047)	(0.010)	(0.005)	(0.012)	(0.010)	(0.010)	(0.018)
Bank Funding	0.001	−0.002	−0.002	−0.001	−0.006	−0.002	−0.001	−0.001	−0.009
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.002)	(0.002)
Liquidity	−0.243	0.248	−0.013	0.006	0.006*	0.003**	0.013***	0.012***	0.0451**
	(0.412)	(0.422)	(0.103)	(0.005)	(0.003)	(0.006)	(0.003)	(0.004)	(0.009)
Loan ratio	0.010	−0.026***	−0.017***	−0.003	0.073*	0.044	0.004***	−0.007	−0.006
	(0.014)	(0.009)	(0.005)	(0.031)	(0.045)	(0.030)	(0.000)	(0.000)	(0.000)
Income diversity	−0.006	0.005***	−0.013*	0.015	0.017	0.050*	−0.016	−0.037	−0.095
	(0.003)	(0.005)	(0.001)	(0.021)	(0.011)	(0.022)	(0.013)	(0.018)	(0.046)
Bank Efficiency	0.057	0.005	0.043	0.057	−0.041	0.010	−0.005	−0.014*	−0.016*
	(0.067)	(0.065)	(0.059)	(0.064)	(0.003)	(0.002)	(0.005)	(0.009)	(0.010)
Profitability	0.010	−0.105	0.005	0.281	−0.683**	−0.422	−0.142	−0.518**	−0.733**
	(0.013)	(0.011)	(0.004)	(0.201)	(0.311)	(0.445)	(0.542)	(0.375)	(0.223)
Economic growth	0.001	−0.004	−0.008	0.003	0.070	0.005	−0.001	−0.049**	−0.115*
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	−0.053	0.071	0.022	−0.127	0.123***	0.055	0.031	0.135***	0.136***
	(0.081)	(0.065)	(0.024)	(0.031)	(0.022)	(0.051)	(0.032)	(0.044)	(0.035)
Observations	2,890	2,890	2,890	3,502	3,502	3,502	10,608	10,608	10,608
Number of ids	170	170	170	206	206	206	624	624	624
Hansen Value	0.251	0.233	0.318	0.424	0.235	0.222	0.524	0.543	0.623
AR (2)	0.566	0.538	0.472	0.571	0.522	0.744	0.577	0.197	0.154

This table used two-step GMM method to measure the speeds of adjustment for well-capitalized, adequately capitalized, and under-capitalized banks by using three alternative capital ratios. Capital ratio (Total Equity/Total Asset's ratio) results are reported in Columns 1,4,7; regulatory ratio (Tier I + II/Total Risk-weighted assets ratio) results are documented in Columns 2,5,8; and Tier-I ratio (Tier I/Total Risk-weighted Assets' ratio) results are disclosed in Columns 3,6 and 9. Columns 1–3 report the results for well-capitalized banks; Columns 4–6 report the results for adequately capitalized banks; Columns 7–9 report the results for under-capitalized banks. A well-capitalized bank has an overall risk-based capital ratio (Tier I + II/Total Risk-weighted assets ratio) of 10 percent or more; and a ratio less than or equal to 8 percent is considered under-capitalized. A ratio between 8 and 10 percent is possessed by adequately capitalized banks. Robust standard errors are reported in parentheses. ***, **, * represent statistical significance at 1%,5% and 10%, respectively.

Table 7. Mechanisms of changes in the balance sheet in reaction to capital surplus and capital deficit.

	Capital ratio gap			Tier-I gap			Regulatory ratio gap			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Adjustment System	WC	AC	UC	WC	AC	UC	WC	AC	UC	p-values
Δ Capital Ratio	−7.31	0.02	4.01	−2.52	0.02	4.13	−6.89	0.03	6.99	0.000***
G Capital Ratio	−7.21	1.60	14.3	−4.12	2.96	5.33	−3.19	0.79	6.11	0.000***
Total Assets	16.13	14.37	−11.37	8.19	9.17	2.37	8.12	11.39	3.17	0.000***
Total Liabilities	8.16	14.12	6.35	7.83	8.90	5.25	6.72	5.28	5.72	0.000***
Common Equity	5.23	13.81	15.82	7.34	12.12	16.22	7.33	11.66	13.13	0.000***
Net Loans	7.73	6.72	4.89	9.23	6.82	4.88	3.31	5.15	3.88	0.000***
Risk-Weighted Assets	8.41	7.91	6.61	9.51	8.92	4.46	10.24	8.31	3.23	0.000***
LT Borrowing	3.89	2.28	0.31	2.93	0.92	0.33	3.91	3.28	0.21	0.000***
ST Borrowing	0.74	0.52	0.32	0.94	0.92	0.33	0.74	0.51	0.31	0.000***
Internal Capital	0.88	4.22	3.81	2.38	6.31	3.27	3.20	6.51	3.12	0.000***
External Capital	7.73	10.96	14.12	7.23	9.99	16.32	8.78	9.62	15.32	0.000***

This table provides evidence of whether the average annual growth rates of the main banks" adjustment mechanisms vary in various quintiles of the capital ratio deviation (gap) for three definitions of capital, i.e., capital ratio (Total Equity/ Total Asset's ratio), regulatory ratio (Tier I + II/Total Risk-weighted assets ratio) and Tier-I ratio (Tier I/Total Risk-weighted Assets' ratio). All variables are expressed in percentages. Based on annual capital adequacy quartiles, well-capitalized banks fall in first quartile, under-capitalized banks possess the bottom quartile, and rest of the banks fall in adequately capitalized category. ***, **, * represent statistical significance at 1%,5% and 10%, respectively.

And, the time required to adjust the capital ratio is consistent with (Abbas & Masood, 2020a, 2020b; De Jonghe & Öztekin, 2015). The findings have important economic meanings in the sense that *ceteris paribus* well-capitalized banks have easy access to the capital market than adequately capitalized and under-capitalized banks. Due to this theoretical reason, the speed of adjustment is justified in terms of bank categories.

4.5. Do banks use assets or liabilities to adjust their capital ratios?

The results of the adjustments in the balance sheet items for the capital ratio gaps of well-capitalized, adequately capitalized, and under-capitalized banks over the sample period are shown in Table 7. Columns 1–3 (Columns 4–6) show the balance sheet adjustments for capital (Tier-I) ratio gaps of well-capitalized, adequately capitalized, and under-capitalized, respectively. Whereas, Columns 7–9 report the balance sheet adjustments for regulatory ratio gaps of well-capitalized, adequately capitalized, and under-capitalized banks, respectively.

The results in Table 7 indicate that well-capitalized banks reduce their capital ratio by −7.31%, -2.25% and −6.89% to meet their target capital, Tier-I and regulatory capital ratio, respectively. On the other hand, adequately capitalized and under-capitalized banks increase their capital ratio to meet their targets. The findings remain the same even in the analysis of growth in capital ratios. These findings highlight that well-capitalized banks issue less common equity than adequately capitalized and under-capitalized banks to achieve their target capital, Tier-I and regulatory ratios. Indeed, banks had no incentive to increase their capital ratios beyond their target ratios because of the opportunity cost and an increase in the ongoing expense of the surplus capital. A significantly higher value of net loans and risk-weighted assets for well-capitalized banks than adequately capitalized and under-capitalized banks means that well-capitalized banks use net loans and risk-weighted assets to adjust their capital ratios. Furthermore, on the liability side, the findings suggest that well-capitalized banks use

Table 8. Capital ratio adjustment during the pre- and post-GFC period.

	Pre-GFC results			Post-GFC results		
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Capital ratio	Regulatory ratio	Tier-I ratio	Capital ratio	Regulatory ratio	Tier-I ratio
Lag dep. variable	0.834***	0.621***	0.831***	0.671***	0.653***	0.878***
	(0.110)	(0.030)	(0.102)	(0.313)	(0.077)	(0.004)
Bank Size	−0.001	−0.002**	−0.0002	−0.001	−0.038***	−0.002***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)
Credit Risk	0.147	0.650***	0.247	−0.512*	0.220	0.233*
	(0.185)	(0.235)	(0.183)	(0.277)	(0.194)	(0.125)
RWATA	0.006	−0.031***	−0.042***	0.029***	−0.067***	−0.034***
	(0.007)	(0.008)	(0.009)	(0.008)	(0.009)	(0.005)
Bank Funding	−0.001	−0.0007	−0.006	−0.018***	0.004***	−0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.006)	(0.000)
Liquidity	0.002	0.001	0.009	0.002***	0.001**	0.004*
	(0.006)	(0.000)	(0.000)	(0.006)	(0.005)	(0.002)
Loan ratio	0.017	0.004	0.006	0.009**	−0.006	0.007
	(0.018)	(0.038)	(0.021)	(0.006)	(0.008)	(0.006)
Income diversity	0.004	−0.013	−0.027	0.143***	0.037	0.010
	(0.037)	(0.016)	(0.032)	(0.042)	(0.031)	(0.010)
Bank Efficiency	−0.004	−0.001	0.004	0.014***	−0.017	−0.004**
	(0.004)	(0.003)	(0.006)	(0.004)	(0.003)	(0.001)
Profitability	−0.580	0.575	1.569	−1.768***	−0.913*	−0.563***
	(1.676)	(0.873)	(1.704)	(0.591)	(0.470)	(0.128)
Economic growth	−0.002	−0.007	−0.002	0.007**	−0.005***	−0.001***
	(0.001)	(0.009)	(0.001)	(0.000)	(0.000)	(0.000)
Constant	0.0493	0.157***	0.0483	−0.0492	0.155***	0.0898***
	(0.038)	(0.058)	(0.050)	(0.035)	(0.053)	(0.013)
Observations	5,000	5,000	5,000	9,000	9,000	9,000
Number of id	1000	1000	1000	1000	1000	1000
Hansen Value	0.76	0.22	0.72	0.41	0.73	0.75
AR (2)	0.57	0.83	0.52	0.26	0.37	0.21

This table used two-step GMM method to measure the speeds of adjustment for pre- and post-GFC periods by using three alternative capital ratios. Capital ratio (Total Equity/Total Asset's ratio) results are reported in Columns 1 and 4; regulatory ratio (Tier I + II/Total Risk-weighted assets ratio) results are posted in Columns 2 and 5; and Tier-I ratio (Tier I/Total Risk-weighted Assets' ratio) results are documented in Columns 3 and 6. The pre-GFC period is 2002 to 2006, and the post-GFC period is from 2010 to 2019. Robust standard errors are reported in parentheses. ***, **, * represent statistical significance at 1%,5% and 10%, respectively.

long-term and short-term borrowings compared to adequately capitalized and under-capitalized to achieve their target capital, Tier-I and regulatory ratios.

4.6. Does capital adjustment vary between pre- and post-GFC period?

Our study also compares the speeds of capital adjustment in pre and post-GFC periods in the US banks. Table 8 contains the empirical findings for capital ratios, regulatory ratios, and the Tier-I ratio of the US commercial banks for pre-GFC in Columns 1–3 and post-GFC in Columns 4–6, respectively. The results suggest that the speed of adjustment for the capital ratio is lower in the post-GFC era; however, the speed of adjusting a regulatory ratio and Tier-I is higher in the post-GFC period compared to the pre-GFC era. One reason for the rapid adjustment of a regulatory ratio is the recent development in banking regulations.

Table 9. Capital ratio adjustments vary across bank size.

	Large Banks results			Smaller Banks results		
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Capital ratio	Regulatory ratio	Tier-I ratio	Capital ratio	Regulatory ratio	Tier-I ratio
Lag dep. variable	0.743***	0.660***	0.735***	0.650***	0.820***	0.801***
	(0.003)	(0.012)	(0.002)	(0.005)	(0.001)	(0.004)
SIZE	−0.001	−0.002***	−0.002***	−0.002***	−0.001***	−0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Credit Risk	0.138***	0.627***	0.357***	0.396***	0.165***	0.107***
	(0.038)	(0.076)	(0.042)	(0.047)	(0.035)	(0.016)
RWATA	0.006**	−0.056***	−0.038***	−0.042***	0.008***	0.021***
	(0.002)	(0.006)	(0.004)	(0.004)	(0.002)	(0.000)
Retail Funding	−0.002***	0.002***	−0.001***	0.001***	−0.002	−0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Liquidity	−0.016	0.011	−0.015	−0.008	−0.011	−0.001
	(0.013)	(0.023)	(0.016)	(0.019)	(0.012)	(0.030)
Loan Growth	0.002	0.004	0.004	0.003	0.002	0.002
	(0.003)	(0.006)	(0.003)	(0.004)	(0.002)	(0.000)
Diversification	0.009**	0.006	0.013***	0.006	0.010***	0.002***
	(0.004)	(0.007)	(0.004)	(0.005)	(0.004)	(0.001)
Efficiency	−0.003	−0.002	−0.002**	−0.003**	−0.001**	−0.004**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Profitability	−0.143	0.125	−0.201*	−0.022	−0.157	−0.207
	(0.106)	(0.199)	(0.106)	(0.149)	(0.110)	(0.031)
GDPR	−0.021***	−0.001***	−0.001***	−0.001***	−0.004***	−0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	−0.053	0.267***	0.099***	0.056	0.268***	0.059
	(0.006)	(0.024)	(0.037)	(0.020)	(0.059)	(0.051)
Observations	4,250	4,250	4,250	4,250	4,250	4,250
Number of id	250	250	250	250	250	250
Hansen p Value	0.55	0.85	0.86	0.87	0.46	0.93
AR (2)	0.35	0.28	0.32	0.58	0.74	0.63

This table used two-step GMM method to measure the speeds of adjustment for large and small banks by using three alternative capital ratios. Capital ratio (Total Equity/Total Asset's ratio) results are reported in Columns 1 and 4; regulatory ratio (Tier I + II/Total Risk-weighted assets ratio) results are posted in Columns 2 and 5; and Tier-I ratio (Tier I/Total Risk-weighted Assets' ratio) results are documented in Columns 3 and 6. After constructing annual quartiles of bank size, large banks fall in top quartile and small banks fall in bottom quartile. Robust standard errors are reported in parentheses. ***, **, * represent statistical significance at 1%,5% and 10%, respectively.

4.7. Robustness checks

The study conducts several checks concerning baseline model results. For example, the OLS fixed-effects are applied to Equation (3), and the outcomes remain consistent with baseline estimations. In Table 9 we report the results for large and small banks only. Our findings in Table 9 show that the speeds of adjustment for large (small) banks are 25.7% (35%), 34% (18%), and 26.5% (19.9%) for capital ratios, regulatory ratios, and Tier-I ratios, respectively. These findings suggest that large (small) banks adjust their capital ratio faster (slower) than regulatory and Tier-I ratio. Our results confirm that the speed of capital adjustment varies with bank size.

Table 10 reports the findings of the capital ratio adjustment for high and low liquid banks. Our results show that the pace of capital ratio adjustment is faster for high liquid banks than low liquid banks. However, the speed of regulatory ratio adjustment and the Tier-I ratio of low liquid banks is faster than high liquid banks. The results remain consistent with the baseline results.

Table 10. Adjustment of capital ratios for high and low liquid banks.

	High liquid			Low liquid		
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Capital ratio	Regulatory ratio	Tier-I ratio	Capital ratio	Regulatory ratio	Tier-I ratio
Lag dep. variable	0.625***	0.655***	0.689***	0.724***	0.621***	0.571***
	(0.003)	(0.001)	(0.001)	(0.001)	(0.006)	(0.009)
SIZE	0.001***	−0.001***	−0.001***	−0.001**	−0.001**	0.002**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Credit Risk	−0.025	0.535***	0.315***	0.297***	0.157***	0.012***
	(0.048)	(0.059)	(0.045)	(0.055)	(0.040)	(0.001)
RWATA	0.009***	−0.049***	−0.040***	−0.040***	0.023***	0.007***
	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.000)
Retail Funding	−0.006***	−0.008***	−0.006***	−0.005***	−0.007***	−0.002***
	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
Liquidity	0.075***	0.013	0.013	0.067*	0.044*	0.004*
	(0.027)	(0.034)	(0.030)	(0.037)	(0.023)	(0.024)
Loan Growth	0.010***	0.012***	0.008**	0.007	0.005**	0.004**
	(0.003)	(0.004)	(0.003)	(0.005)	(0.002)	(0.000)
Diversification	0.016***	0.020***	0.013**	0.002	0.011**	0.012**
	(0.006)	(0.007)	(0.006)	(0.008)	(0.005)	(0.004)
Efficiency	−0.001	−0.001**	−0.001	−0.003*	0.002**	0.001*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Profitability	−0.295*	−0.104*	−0.048**	0.208	−0.023	−0.033**
	(0.165)	(0.206)	(0.169)	(0.246)	(0.136)	(0.110)
GDPR	0.002**	0.004***	0.004***	0.001	0.003***	0.002***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
Constant	0.001	0.236***	0.018***	0.004**	0.234**	0.228***
	(0.011)	(0.038)	(0.015)	(0.028)	(0.010)	(0.010)
Observations	8,500	8,500	8,500	8,500	8,500	8,500
Number of id	500	500	500	500	500	500
Hansen p Value	0.62	0.66	0.61	0.47	0.48	0.87
AR (2)	0.94	0.41	0.80	0.23	0.29	0.24

This table used two-step GMM method to measure the speeds of adjustment for high and low liquid banks by using three alternative capital ratios. Capital ratio (Total Equity/Total Asset's ratio) results are reported in Columns 1 and 4; regulatory ratio (Tier I + II/Total Risk-weighted assets ratio) results are posted in Columns 2 and 5; and Tier-I ratio (Tier I/Total Risk-weighted Assets' ratio) results are documented in Columns 3 and 6. Based on annual cross-sectional median liquidity value, above median are highly liquid banks, and low liquid banks otherwise. Robust standard errors are reported in parentheses. ***, **, * represent statistical significance at 1%,5% and 10%, respectively.

5. Conclusion and policy implications

Existing studies have investigated the impact of bank capital ratios on risk-taking and financial performance in the post-GFC era; however, the factors responsible for adjusting capital ratios and speed of adjustment for capital ratios have been a void in the existing literature. The main aim of our study is to fill this gap in the existing literature.

The study uses GMM framework on the data of the US commercial banks over the period from 2002 to 2018 to show that banks adjust their regulatory capital ratios faster than traditional capital ratios; and, in most cases, the speed of adjustment of a traditional capital ratio is lower than regulatory capital ratios.

Our results show that the pace of regulatory capital ratio of well-capitalized banks is faster than adequately capitalized and under-capitalized banks. Our analysis report that high-liquid banks adjust their capital ratios faster than low-liquid banks. We also find that the speed of adjustment of the regulatory capital of too-big-to-fail banks is lower than well-capitalized, adequately capitalized, nationally chartered, and state-chartered

banks. In addition, the speed of adjustment of regulatory capital ratios of commercial banks is higher in the post-GFC period than in the pre-GFC era.

Although scholars suggest that adjustment of capital ratios through rebalancing liabilities is more beneficial to the banks, our findings show that banks use more of their asset side of the balance sheet to rebalance their capital ratios. The findings are also heterogeneous in the case of the pre- and post-GFC eras. The speed of adjustment regulatory capital ratio of commercial banks is higher in the post-GFC period than in the pre-GFC era.

Our findings have important implications for regulators. For instance, the variations in the speed of capital adjustment across economic conditions (pre-post GFC) and the heterogeneity in the speed of capital adjustment across banks' capital adequacy, liquidity, size, and economic conditions suggest that the regulators may consider this heterogeneity across different bank characteristics for the formulation of new regulations about the adjustment of bank capital ratios. These findings may be particularly useful for supervisors when assessing and adjusting the specific capital requirements through Pillar II of the Basel III agreement.

The results of our study remain limited to the analysis of large commercial banks. Here, we are still unable to collect data for a longer period and smaller commercial banks, saving banks, cooperative banks, and investment banks. Future research could focus on the speed of adjustment of capital ratios for banks under the mediating/moderating role of other economic variables and bank regulations to get better in-depth insights.

Disclosure statement

No potential conflict of interest was reported by the authors.

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