Article

Bank Capital Buffer and Economic Growth: New Insights from the US Banking Sector

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Abstract: This research intends to explore the relationship between capital buffer, nominator effect, denominator effect, and economic growth for large insured commercial banks of the USA. The study applied a two-step system Generalized Method of Moment (GMM) framework by taking the unique and comprehensive dataset over the period extending from 2002 to 2018. The research found a countercyclical relationship between a capital buffer and economic growth. In the case of well-capitalized banks, this relationship is more critical than adequately capitalized banks. In the case of low-liquid banks, counter-cyclicality is more significant than high-liquid banks. The results also suggest the pro-cyclical relationship between nominator, denominator, and economic growth. The results remain consistent and robust with the use of the tier-one capital buffer ratio. The findings have implications for regulators to incorporate the counter-cyclicality between the capital buffer and economic growth, while formulating the policies for capital requirements in the future.

Keywords: commercial banks; countercyclical; pro-cyclical; two-step GMM

JEL Classification: E44; G18

1. Introduction

In the wake of the global financial crisis, the Basel Committee has re-examined the original Basel Convention and set up another administrative structure, the so-called Basel III, which proposes increasingly strict requirements for monetary institutions. The counter-cyclical capital structure was offered to improve the bank's stability in different business conditions, which became an integral part of the new framework for the larger financial institutions. The capital structure refers to the pre-requisite disparity between the capital level and the regulator. The cyclicality between the capital base and the market cycles had been seen as a significant factor that led banks to become helpless in the 2008 economic crisis (Huang and Xiong 2015). The banks are inclined to receive healthy thinking towards their organizations during financial upswings due to an increase in advances requests and a decrease in capital requirements. The bank's risk-taking and growth rates are becoming vulnerable in the face of adverse financial shocks (Huang and Xiong 2015). The Basel Committee supported the countercyclical capital buffer need to mitigate pro-cyclical capital buffer impacts. This component expects banks to build additional capital buffers during a financial upswing as a safety measure for future vulnerabilities. If this system is working, every bank needs to change its capital proportion in a countercyclical design. The changes in the scale of the bank's capital affect the credit supply and risk-taking of the financial sector to manage unforeseen economic uncertainties.

As the largest economy in the world, the US has one of the world's largest and most well-regulated financial markets. In the previous decade, regulators employed different restrictions on banks, especially in terms of their capital ratios. The Basel Committee on Banking Supervision (BCBS) recommends that the capital adequacy ratio should be 8%, a tier-I risk-based ratio of 6%, and a common equity ratio of 4.5% of risk-weighted assets. Basel III also expects banks to provide capital protection in the form of a prudent capital buffer equivalent to 2.5% of risk-weighted assets. The regulators recommend an anticyclical capital buffer that may differ between 0 and 2.5% of risk-weighted assets. The following questions, therefore, need to be answered. Would capital buffers in the US banking industry, which did not appear to have an impact during the last financial crisis, provide a unique example of what has been seen in the past reviews? If this is true, how does the capital buffer influence banking practices and, therefore, the current fluctuations in economic growth? Eventually, to examine whether the relationship between a capital buffer and economic growth is pro-cyclical or countercyclical, does the relationship stay identical for well-capitalized, adequately capitalized, high-liquid, and low-liquid banks?

In the aftermath of the last financial crisis, capital ratio adjustment and macroeconomic scenarios were discussed with transformed attention as argued by (Abbas et al. 2019a; Abbas and Masood 2020a; De Jonghe and Öztekin 2015; Huang and Xiong 2015; Jiang et al. 2019; Jokipii and Milne 2011). Scrutinized literature provides inconclusive results, whether capital ratios are pro-cyclical or countercyclical. Besides, the capital buffer is pro-cyclical or countercyclical for either well-capitalized, adequately capitalized, high- and low-liquid banks, or the industry as a whole. To our information, this is the first study to explore the relationship between a capital buffer and macro-economic fluctuations using the extensive dataset from commercial banks in the USA. The study contributes to the literature by providing evidence of well-capitalized, adequately capitalized, and high-liquid and low-liquid banks. We help investigate whether capital buffer and economic growth are pro-cyclical or countercyclical for well-capitalized, adequately capitalized banks, and high- and low-liquid banks in the US. The study enriches the literature by providing evidence of the impact on denominators and nominator factors of the capital buffers. The results of the study increase the comprehension and strength of relationships with more recent data from large commercial banks from 2002 to 2018. The discovered insights should motivate and empower governments, regulators, and policymakers to find countercyclical (pro-cyclical) capital buffers in macroeconomic policy guidance.

The article is structured as follows: the next section contains a review of the related literature, the third part provides data sources and methods (including econometric models), Section 4 includes results and discussion, and the final section concludes the research.

2. Literature Review and Hypotheses Development

The existing literature about the bank capital buffer motivates us to explore new insights for the most regulated financial system of the globe, particularly connected with the study of the bank capital ratios and economic growth (Abbas and Masood 2020a, 2020b; Allahrakha et al. 2018; Atici and Gursoy 2013; Ayuso et al. 2004; Bakkar et al. 2019; Huang and Xiong 2015; Jiang et al. 2019).

2.1. Capital Buffer and Bank Lending

Recommendations on higher capital levels have had a significant effect on depository institutions. In the innate sense of banking, theoretical and observational data support the inverse association between higher capital holding and bank lending. The capital buffer increases banks' loss of absorption ability to thrive under adverse economic conditions (Bitar et al. 2018; Majnoni et al. 2000). In either event, as another example of a prevalent pro-cyclical capital reserve system, the US banking sector did not appear robust in the most recent economic catastrophe. Banks did not grasp the capital deficit and the credit crisis during the economic downturn that happened in 2007–2009. In subsequent studies (Huang and Xiong 2015; Majnoni et al. 2000; Rime 2001; Watanabe 2007), the relationship

was investigated. Huang and Xiong (2015) predict the decrease in lending growth in China because of capital buffer increases. Berger (2006) argues that commercial banks reduce unnecessary lending to small and medium enterprises (SMEs) to increase capital. The pro-cyclical partnership between bank lending and business development improves lenders' credit value. Therefore, banks need to increase their capital to satisfy credit demand.

On the other hand, borrowers' deteriorated credit rating raises the default and credit risk, which requires banks to increase their capital to manage this situation. Strict regulations to maintain a higher capital buffer allow decreasing lending to raise their capital ratio (Chami and Cosimano 2010). Xiong (2013) discover and announce an anti-cyclical interaction between capital buffers and bank loans. He claims that the rise in the capital buffer during an economic boom contributes to a reduction in loan availability. Tabak et al. (2011) reveal that an increase in the capital buffer under better economic conditions leads to a decrease in the credit supply of Brazilian commercial banks. Coffinet et al. (2012) and Mora and Logan (2012) also conclude an inverse relationship between buffer capital and bank lending. Huang and Xiong (2015) found an inverse relationship between the capital buffer and the deposit income. We also record that the link is more critical under poor economic conditions.

2.2. Capital Buffer and Economic Fluctuations

The previous literature discusses two facets of retaining higher-capital buffers. The first background is addressing asymmetric knowledge between depositors and banks. As a significant fund supplier, depositors conclude that low-capitalized banks have enormous loss-absorption potential. Consequently, they continue to claim a lower deposit income. Lower deposit premium reduces bank capital rate. Secondly, they are able to keep larger capital buffers and reduce compliance costs (Bolton and Freixas 2006; Fonseca and González 2010; Meh and Moran 2010).

Capital buffer remains key to bank risk-taking at different periods of market volatility. Most research exploring the connection between a capital buffer and economic cycles remains unresolved. Studies that support the countercyclical between a capital buffer and economic cycles include (Ayuso et al. 2004; Fonseca and González 2010; Huang and Xiong 2015; Jokipii and Milne 2008). Jokipii and Milne (2008) uncover the negative link between the capital buffer and the business cycle in the sample of EU15 countries. This countercyclical outcome is for commercial, savings, and large banking firms. Benes and Kumhof (2015) conducted a study to explore the role of risky bank lending and bank countercyclical capital buffer. Under the Basel-III regulations, banks need to maintain an endogenous capital conservation buffer and countercyclical capital buffer. The findings confirm that an increase in countercyclical capital buffer increases the loss absorption capacity of banks. Moudud-Ul-Huq (2019) investigates the relationship between economic conditions, bank efficiency, and capital buffer in Bangladesh over the period from 2000 to 2014. The study concludes that there is a negative relationship between the business cycle and bank capital buffers. In light of the above, we hypothesize the following relationship:

Hypothesis 1 (H1). *Capital buffers and economic growth fluctuate countercyclically; capital buffers are affected by changes in the denominator.*

Valencia and Bolaños (2018) investigate the role of economic cycles in capital buffer movement. They conclude and endorse the pro-cyclical trend between buffer capital and the business cycle. However, commercial banks have maintained a more significant capital buffer in developing economies than in developed ones. Jokipii and Milne (2008) explore positive co-movement between a capital buffer and the business cycle for cooperative and smaller banks. Repullo and Suarez (2013) provide that business cycle and bank capital buffer is pro-cyclical. They also record that banks establish a precautionary capital buffer, and this trend is more critical for Basel-II than Basel-I. A higher capital buffer costs more than a failure. Moudud-Ul-Huq (2019) finds that there is a positive relationship between the business cycle and bank risk-taking. The study confirms that low buffer banks increase

their capital buffer, which leads to improving banks' efficiency. Berger (2006) opines that commercial banks reduce lending to SMEs to boost up their capital ratio. The pro-cyclical relationship between bank lending and business growth improves lenders' credit value. Therefore, banks need to increase their capital to satisfy credit demand. Stolz and Wedow (2011) investigate the effect of the business cycle on the capital buffers of German banks over the period 1993–2004. The study confirms that capital buffer and the business cycle fluctuate countercyclically. The study also concludes that low-capitalized banks do not decrease their risk assets during a recession ears. Grosse and Schumann (2014) explore the cyclical behavior of German banks' capital buffer ratio under the setting of the Basel-III framework. The study concludes that there is a certain pro-cyclicality of capital buffer ratio in German banks. Carvallo et al. (2015) probe in their study the relationship between the capital buffer and the business cycle in the banks located in Latin American and Caribbean economies over the period from 2001 to 2012. The findings provide different cyclical trends of a capital buffer across economies. The outcomes suggest a procyclical trend of the capital buffer, where the cost of adjustment is lower. In addition, the banks' capital buffer fluctuates procyclically where the capital regulations are relaxed. In light of the above, we hypothesize the following relationship:

Hypothesis 2 (H2). *Capital buffers and economic growth fluctuate pro-cyclically; capital buffers are affected by changes in the numerator.*

3. Data and Methods

The bank's financial specific information was collected from annual financial statements as published by Federal Deposit Insurance Corporation (FDIC). We focus only on large insured commercial banks. The data for 933 banks collected and used in this study cover the period ranging from 2002 to 2018. The banks are categorized into well, adequately capitalized banks based on Basel criteria for capitalization (Bank with risk-based capital ratio (tier I + II/total risk-weighted assets ratio) of 10% or above is well-capitalized and if its between 8 to 10% then it's a adequately capitalized banks). The banks are further divided into high- and low-liquid bank categories based on the average liquid ratio for seventeen years. The banks in the top half are considered as high-liquid and low-liquid ones otherwise. The goal is to deepen the understanding of the relationship and the robustness of the results by classifying large commercial banking banks in separate sections. The real gross domestic product rate (RGDPR) was collected from the World Bank's economic indicators database. The list and measurement of variables are as below.

Empirical Model

In the light of previous literature (Huang and Xiong 2015; Jokipii and Milne 2008; Stolz and Wedow 2011), we established Equation (1) to investigate the movement of capital buffer and economic growth:

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

where Y is the capital buffer for bank i in year t, $t-1$ is the lag value of capital buffer, X is economic growth, Z represents control variables, and ε is an error term. In this study, we follow the measurement provided in previous literature. Capital buffer ratios and capital ratios are similar to (Huang and Xiong 2015; Jokipii and Milne 2008; Moudud-Ul-Huq 2019) economic growth uses in the study of (Moudud-Ul-Huq 2019; Tabak et al. 2011). The measurement of bank risk, non-performing loans, liquidity, profitability, market share, loan growth, income diversification, bank efficiency, and size are consistent with the following studies (Abbas et al. 2019a; Abbas et al. 2019b; Altunbas et al. 2007; Bitar et al. 2018; Huang and Xiong 2015; Jacques and Nigro 1997; Lee and Hsieh 2013; Moudud-Ul-Huq 2019). We extended the capital buffer adjustment model and classified it into the capital ratio as the numerator effect and denominator effect. The term "numerator" means that banks adjust their capital buffer ratio by changing the numerators of capital ratio in definite words use

of equity, and the term "denominator effect" means that banks adjust their capital buffer ratio by changing their risk-weighted assets. The denominator and numerator effects are similar to the study of (Huang and Xiong 2015; Moudud-Ul-Huq 2019). Equations (2) and (3) below were explored to investigate the two earlier effects:

$$Risk_{i,t} = \alpha + \beta_1 Risk_{i,t-1} + \beta_2 X_{i,t} + \beta_3 Z_{i,t} + \varepsilon, \qquad (2)$$

$$Cap_{i,t} = \alpha + \beta_1 Cap_{i,t-1} + \beta_2 X_{i,t} + \beta_3 Z_{i,t} + \varepsilon. \qquad (3)$$

In Equations (2) and (3), the control variables are similar to Equation (1). In Equation (2), $Risk_{i,t}$ is representing the denominator effect for bank i and year t measured as risk-weighted assets to total assets. In Equation (3), $Cap_{i,t}$ shows the numerator effect for bank i and year i measured as total equity capital to total assets. Equations (1)–(3) include the first-order lagged dependent terms as explanatory variables. The study uses a two-step system GMM technique in estimating the consistent and unbiased coefficients. Using GMM solves the problem of endogeneity, heteroscedasticity, and autocorrelation and provides a consistent coefficient in the model in the presence of lag-dependent variables. The use of two-step GMM is better and more consistent than one-step GMM (Windmeijer 2005).

4. Results and Discussion

4.1. Descriptive Statistics

Table 1 contains the information for the proxies used in the study. The average ratio of a capital buffer is 5.9%, with a standard deviation of 2.1%. The maximum rate of a capital buffer is 9.2%, where the minimum value of capital ratio 7.8%, with a standard deviation of 1.8%. The standard deviation of the tier-one buffer is 1.9%, and the maximum rate is 9.3%. Table 2 reports the correlation matrix, and the results reveal that most of the coefficients are less than 5%. The sign and significance of correlation coefficients remain in a desirable range. The relationship between variables is as per the economic rationale, and no abnormality is found. The findings also confirm that there is no problem of high multicollinearity in explanatory variables.

Table 1. Variables measurement and descriptive statistics.

Variable	Measurement	Mean	Std. Dev.	Min	Max
Capital Buffer	Risk-based capital ratio minus 8% (Jiang et al. 2019)	0.059	0.021	0.033	0.092
Tier-I Buffer	Risk-based tier-I capital ratio minus 6% (Hessou 2017)	0.066	0.019	0.043	0.095
Capital	Nominator effect—total capital to total assets (Abbas et al. 2021a)	0.102	0.018	0.078	0.136
Risk	denominator effect—risk-weighted assets to total assets (Ali et al. 2019)	0.723	0.110	0.494	0.901
Non performing loans (NPL)	Non-performing loans to total assets (Bolognesi et al. 2020)	0.008	0.008	0.000	0.026
Liquidity	Liquid assets to total assets (Ali et al. 2020)	0.048	0.027	0.021	0.095
Profitability	Net income to total assets (Yousaf et al. 2019a)	0.010	0.005	−0.001	0.020
Loans	Yearly growth in loans (Abbas and Ali 2020)	0.714	0.148	0.431	0.974
Market Power	Bank deposit to total industrial assets (Al Arif and Awwaliyah 2019)	0.139	0.271	−0.171	2.909
Diversification	Non-interest income to gross revenues (Abbas et al. 2021b)	0.463	0.098	0.262	0.593
Efficiency	Cost to income ratio (Abbas et al. 2021c)	3.048	1.756	0.906	6.852
Size	Natural log of total assets (Yousaf et al. 2019b)	13.554	0.950	12.259	15.368
GDP	Real growth in gross domestic product (Fotis et al. 2017)	2.084	1.038	−0.292	3.345

This table reports summary statistics of our variables of study over the period from 2002 to 2018. Mean and standard deviation refers to the cross-sectional average and standard deviation of the firms' time-series averages.

Table 2. Matrix of correlation.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Capital Buffer	1											
Capital	0.489	1										
Risk	−0.510	0.026	1									
NPL	0.002	0.057	0.096	1								
Liquidity	0.191	0.047	−0.144	0.091	1							
Profitability	0.073	0.088	0.049	−0.294	−0.087	1						
Loans	−0.446	−0.085	0.663	0.031	−0.161	0.038	1					
Market Power	−0.024	0.011	0.018	0.034	0.032	0.029	−0.074	1				
Diversification	0.094	0.116	−0.006	−0.296	0.038	0.584	−0.083	0.110	1			
Efficiency	0.003	−0.063	−0.041	0.183	0.098	−0.486	−0.024	−0.021	−0.218	1		
Size	−0.103	0.122	0.098	0.074	−0.053	−0.013	−0.045	0.101	0.310	−0.032	1	
GDP	0.044	0.021	−0.020	−0.276	−0.042	0.165	−0.004	0.000	0.224	−0.094	−0.022	1

Table 2 reports the pair-wise correlations between our variables of study over the period from 2002 to 2019.

4.2. Capital Buffer and Economic Growth

In the present section, we empirically scrutinize the connection between the changes in capital buffer due to the fluctuations of economic growth in the USA banking industry. The estimating outcomes of a two-step GMM approach in Equations (1)–(3) are provided and contain the results for the robustness check to test the misspecification that could arise from the omission of crucial factors in the model. Sometimes omitted variables have a trivial effect as long as the effects are fixed. The findings show that there is no misspecification of the estimated results. We present the results of the parameters and their relevance to the bank balance sheet and the economic indicators for the desired capital ratios. Post-estimation statistics confirm the strength of the instruments used in each table. The statistics of the Hansen J statistics used to test the exogeneity and over-identification of the instruments. In addition to exogeneity and over-identification, GMM estimators required the absence of second-order autocorrelations in residues. The results reported at the bottom of each table confirm that the instruments used are valid and that there is no problem with over-identification and second-order serial autocorrelation.

Column 1 of Table 3 shows the overall sample results. The predicted findings provide evidence that coefficients of the economic growth are negative and significant to influence the changes in capital buffer ratios. The negative coefficients demonstrate that capital buffers retort negatively over the economic growth, other factors held constant.

Table 3. Bank capital buffer adjustment under macroeconomic fluctuations.

	(1)	(2)	(3)	(4)	(5)
	Full Sample	**Well Capitalized**	**Adequately Capitalized**	**High Liquid**	**Low Liquid**
Variables	**Capital Buffer**	**Capital Buffer**	**Capital Buffer**	**Capital Buffer**	**Capital Buffer**
Lag dep.	0.721 ***	0.555 ***	0.646 ***	0.729 ***	0.707 ***
	(0.027)	(0.061)	(0.061)	(0.036)	(0.041)
NPL	0.211 ***	0.117	0.284 ***	0.229 ***	0.181 ***
	(0.026)	(0.086)	(0.078)	(0.042)	(0.035)
Liquidity	0.063 ***	0.0134	0.056 ***	0.047 ***	0.075 ***
	(0.063)	(0.017)	(0.016)	(0.083)	(0.093)
Profitability	−0.322 ***	−0.127	−0.027	−0.362 ***	−0.315 ***
	(0.069)	(0.265)	(0.163)	(0.088)	(0.109)
Loans	−0.029 ***	−0.017 ***	−0.029 ***	−0.033 ***	−0.028 ***
	(0.019)	(0.039)	(0.045)	(0.027)	(0.025)
Market Power	−0.022 ***	−0.037	0.033	−0.017 **	−0.027 ***
	(0.056)	(0.026)	(0.017)	(0.075)	(0.078)
Diversification	0.018	−0.012	0.013	−0.0252	0.0809 **
	(0.026)	(0.078)	(0.056)	(0.036)	(0.040)

Table 3. *Cont.*

Variables	(1) Full Sample Capital Buffer	(2) Well Capitalized Capital Buffer	(3) Adequately Capitalized Capital Buffer	(4) High Liquid Capital Buffer	(5) Low Liquid Capital Buffer
Efficiency	−0.044 ***	−0.017	−0.031 ***	−0.036 ***	−0.051 ***
	(0.046)	(0.025)	(0.012)	(0.060)	(0.069)
Size	−0.012 ***	−0.022	−0.014 ***	−0.015 ***	−0.011 ***
	(0.023)	(0.076)	(0.050)	(0.030)	(0.036)
GDP	−0.035 ***	−0.081 ***	0.019	−0.032 **	−0.042 **
	(0.012)	(0.028)	(0.032)	(0.016)	(0.017)
Constant	0.066 ***	0.056 ***	0.069 ***	0.072 ***	0.064 ***
	(0.053)	(0.012)	(0.012)	(0.074)	(0.074)
Observations	14,913	2241	1680	7361	7552
Number of id	933	141	105	461	472
AR (2)	0.847	0.970	0.430	0.936	0.893
Instruments	12	12	12	12	12
Sargan Statistics	0.824	0.918	0.808	0.615	0.391
Hansen Statistics	0.868	0.903	0.823	0.625	0.588

Table 3 used a two-step GMM method to measure the impact of macroeconomic fluctuation on banks' capital buffer (ratio of risk-based capital to risk-weighted assets minus 8%) adjustment for the full sample, well, adequately, highly liquid, and low-liquid banks. If the overall risk-based capital ratio (tier I + II/total risk-weighted assets ratio) of banks is 10% or above is well-capitalized, if the ratio is between 8 to 10% then they are adequately capitalized banks. Based on their median value, commercial banks are classified as highly liquid or low-liquid banks. Banks with a higher ratio of liquid assets to deposits and short-term funding than the median are treated as highly liquid banks and low-liquid banks otherwise. Robust standard errors are reported in parentheses. *** and ** represent statistical significance at 1 and 5%, respectively.

The results show that capital buffer ratios tend to increase (decrease) in the lower (higher) phase of economic growth. The findings are consistent with (Jokipii and Milne 2011; Moudud-Ul-Huq 2019; Shim 2013). Banks can boost their capital buffer in a lower economic growth phase or crisis period, either decreasing riskier assets or restructuring capital buffers; the argument is in line with (Moudud-Ul-Huq 2019). In adverse economic conditions, it is hard to issue new equity. Therefore, banks may increase their capital buffer ratio by decreasing risk-weighted assets instead of raising new shares. In Table 3, columns 2, 3, 4, and 5 contain the results of well-capitalized, adequately capitalized, high-liquid and low-liquid banks, respectively.

The sign of economic growth is similar to those in overall results. In the USA, banks maintain a higher capital buffer in adverse economic conditions and a lower capital buffer in a higher economic growth period. The outcomes explore that well-capitalized banks enjoy the terms of easy access to the capital market. The well-capitalized banks are more concerned with loan growth than economic growth. Table 3, column 3 contains the result of adequately capitalized banks. The capital buffer of adequately capitalized banks is not influencing by economic growth; however, banks are linked with portfolio risk and regulatory requirements. The findings show that adequately capitalized banks increase capital buffer with an increase in NPLs. The impact of economic growth is more significant in the case of well-capitalized banks than adequately capitalized banks. Columns 4 and 5 of Table 3 represent the outcomes of high- and low-liquid banks' results, respectively. The capital buffer and economic growth are countercyclical; however, the influence is more considerable in the case of low-liquid banks than high-liquid banks. The findings are favored by the study of (Huang and Xiong 2015). The theory prefers the holding of higher capital buffer in good economic conditions to remain stable in unfortunate economic situations. The countercyclical relationship between economic growth and capital buffer in the USA may exist due to the stringent regulations.

4.3. Nominator Effect and Economic Growth

Table 4 provides the results of the relationship between economic growth and capital ratio; it is also called the nominator effect. Under the nominator effect (see, Shimizu 2015) case, usually, banks adjust their capital level by enhancing profits and issuing new equities, the argument is in line with (Shimizu 2015). The findings conclude a positive relationship between economic growth and the nominator effect; other things held equal. The coefficient of adequately capitalized banks and high-liquid banks is positive and statistically significant. The findings show a pro-cyclical relationship between the nominator and economic growth, which favors the argument that banks earn higher profits in the expansion phase of the economy and require more capital to invest in profitable opportunities. The pro-cyclical relationship between the nominator effect and economic growth is favored by (Huang and Xiong 2015). The results show that the sign of coefficients is robust in well-capitalized, low-liquid commercial banks but is not significant. One explanation for these results may be due to the high cost of the new issue and the role of regulators and vigilant monitoring.

Table 4. Bank capital buffer adjustment under macroeconomic fluctuations (nominator effect).

	(1)	(2)	(3)	(4)	(5)
	Full Sample	Well Capitalized	Adequately Capitalized	High Liquid	Low Liquid
Variables	Capital	Capital	Capital	Capital	Capital
Lag dep.	0.744 ***	0.693 ***	0.516 ***	0.749 ***	0.728 ***
	(0.023)	(0.065)	(0.096)	(0.038)	(0.044)
NPL	0.147 ***	0.194 ***	0.247 ***	0.163 ***	0.097 ***
	(0.022)	(0.062)	(0.090)	(0.035)	(0.028)
Liquidity	−0.0269	0.017	0.016	0.039	−0.077
	(0.051)	(0.017)	(0.018)	(0.073)	(0.073)
Profitability	−0.200 ***	0.087	−0.394 *	−0.139 *	−0.271 ***
	(0.057)	(0.271)	(0.237)	(0.078)	(0.085)
Loans	−0.094 ***	−0.069 *	−0.057	−0.092 ***	−0.017 ***
	(0.001)	(0.003)	(0.006)	(0.002)	(0.002)
Market Power	−0.079	−0.012	0.014	0.000	−0.022 ***
	(0.056)	(0.019)	(0.029)	(0.082)	(0.069)
Diversification	−0.020	−0.013	−0.051	−0.087 ***	0.058 *
	(0.022)	(0.083)	(0.092)	(0.030)	(0.035)
Efficiency	−0.037 ***	−0.023	−0.057 ***	−0.033 ***	−0.042 ***
	(0.039)	(0.025)	(0.014)	(0.056)	(0.055)
Size	0.045 **	0.012	−0.013	0.013	0.065 **
	(0.020)	(0.065)	(0.010)	(0.029)	(0.030)
GDP	0.017 ***	0.034	0.026 **	0.012 **	0.011
	(0.000)	(0.025)	(0.032)	(0.018)	(0.015)
Constant	0.040 ***	0.049 **	0.093 ***	0.044 ***	0.045 ***
	(0.049)	(0.019)	(0.012)	(0.072)	(0.067)
Observations	14,913	2241	1680	7361	7552
Number of id	933	141	105	461	472
AR (2)	0.842	0.282	0.230	0.837	0.941
Instruments	12	12	12	12	12
Sargan value	0.629	0.217	0.941	0.539	0.374
Hansen value	0.653	0.118	0.934	0.517	0.449

Table 4 used a two-step GMM method to measure the impact of economic growth on banks' capital buffer adjustment (ratio of total capital to total assets) for the full sample, well, adequately, highly liquid, and low-liquid banks. If the overall risk-based capital ratio (tier I + II/total risk-weighted assets ratio) of banks is 10% or above it is well-capitalized, if the ratio is between 8 to 10% it is considered an adequately capitalized bank. Based on their median value, commercial banks are classified as highly liquid or low-liquid banks. Banks with a higher ratio of liquid assets to deposits and short-term funding than the median are treated as highly liquid banks and low-liquid banks otherwise. Robust standard errors are reported in parentheses. ***, **, and * represent statistical significance at 1, 5, and 10%, respectively.

4.4. Denominator Effect and Economic Growth

Table 5 contains the results of economic growth and change in risk-weighted assets; it is known as the denominator effect. Under the denominator effect case, usually, banks adjust their capital ratios by restricting their risk-weighted assets (Shimizu 2015). The coefficients of economic growth are positive but only significant in columns 1 and 4. The results show a pro-cyclical relationship between risk-weighted assets and economic growth. The outcomes indicate that overall the relationship between economic growth and risk-weighted assets is positive and statistically significant. The findings also demonstrate that high-liquid banks' risk-weighted assets and economic growth move in a similar direction. One of the explanations is correct for economic prosperity and growth in economic activities. Theoretically, in the expansion phase of economic activities, the banks lend a higher amount due to higher demand, other factors held constant.

Table 5. Bank capital buffer adjustment under macroeconomic fluctuations (denominator effect).

	(1)	(2)	(3)	(4)	(5)
	Full Sample	**Well Capitalized**	**Adequately Capitalized**	**High Liquid**	**Low Liquid**
Variables	**Risk**	**Risk**	**Risk**	**Risk**	**Risk**
Lag dep.	0.725 ***	0.823 ***	0.630 ***	0.826 ***	0.698 ***
	(0.044)	(0.157)	(0.120)	(0.063)	(0.046)
NPL	−0.115	0.672	0.728	−0.076	−0.485 ***
	(0.125)	(0.502)	(0.665)	(0.232)	(0.114)
Liquidity	−0.448 ***	−0.154	−0.265 ***	−0.373 ***	−0.537 ***
	(0.025)	(0.140)	(0.078)	(0.036)	(0.032)
Profitability	−1.485 ***	−4.478 **	−2.650 *	−1.363 ***	−1.384 ***
	(0.339)	(1.720)	(1.367)	(0.429)	(0.464)
Loans	0.111 ***	0.043	0.116 ***	0.078 ***	0.050 ***
	(0.019)	(0.064)	(0.041)	(0.025)	(0.016)
Market Power	0.0385 *	−0.013	0.015	0.020	0.029
	(0.023)	(0.017)	(0.025)	(0.028)	(0.029)
Diversification	0.015	−0.0640	−0.022	−0.002	0.027 *
	(0.011)	(0.069)	(0.047)	(0.017)	(0.015)
Efficiency	−0.012 ***	−0.042 **	−0.024 **	−0.017 ***	−0.010 ***
	(0.002)	(0.016)	(0.009)	(0.004)	(0.003)
Size	−0.037	−0.038	−0.051	−0.000	−0.013
	(0.010)	(0.051)	(0.052)	(0.012)	(0.015)
GDP	0.016 ***	0.028	0.087	0.0146 **	0.011
	(0.049)	(0.019)	(0.002)	(0.070)	(0.071)
Constant	0.191 ***	0.328 **	0.356 **	0.142 ***	0.275 ***
	(0.028)	(0.135)	(0.143)	(0.040)	(0.038)
Observations	14,913	2241	1680	7361	7552
Number of id	933	141	105	461	472
AR (2)	0.313	0.066	0.248	0.165	0.898
Instruments	12	12	12	12	12
Sargan value	0.276	0.549	0.872	0.144	0.347
Hansen value	0.310	0.595	0.884	0.181	0.407

Table 5 used a two-step GMM method to measure the impact of macroeconomic fluctuation on banks' capital buffer (ratio of risk-weighted assets to total assets) adjustment for the full sample, well, adequately, and high- and low-liquid banks. If the overall risk-based capital ratio (tier I + II/total risk-weighted assets ratio) of banks is 10% or above it is well-capitalized, if the ratio is between 8 to 10% it is considered an adequately capitalized bank. Based on their median value, commercial banks are classified as highly liquid or low-liquid banks. Banks with a higher ratio of liquid assets to deposits and short-term funding than the median are treated as highly liquid banks and low-liquid banks otherwise. Robust standard errors are reported in parentheses. ***, **, and * represent statistical significance at 1, 5, and 10%, respectively.

4.5. Robustness

Columns 1, 2, 3, 4, and 5 of Table 6 contain the robustness results. The robustness checks were used to pick the tier 1 capital buffer ratio as a replacement for the capital buffer ratio. Column 1 represents the findings for the overall sample; column 2 reports the

outcomes of well-capitalized banks. Column 3 provides information for adequately capital-ized banks' results, and column 4 contains the findings for high-liquid banks. Column 5 represents the output for low-liquid banks. The results favor key findings and conclusions. The outcomes remain consistent concerning the sign and significance of the coefficients when the model was run separately for well-capitalized banks, adequately capitalized banks, high-liquid banks, and low-liquid banks the results boosted the confidence in favor of baseline findings. We also use the OLS procedures and fixed-effect methods, but the results were not reported for courtesy. The coefficients remain upward bias in the case of OLS and downward bias in the case of a fixed-effects calculation.

Table 6. Bank capital buffer adjustment under macroeconomic fluctuations.

	(1)	(2)	(3)	(4)	(5)
Variables	**Full Sample**	**Well Capitalized**	**Adequately Capitalizedd**	**High Liquid**	**Low Liquid**
	Tier-I Buffer	**Tier-I Buffer**	**Tier-I Buffer**	**Tier-I Buffer**	**Tier-I Buffer**
Lag dep.	0.707 ***	0.506 ***	0.625 ***	0.714 ***	0.696 ***
	(0.029)	(0.066)	(0.060)	(0.036)	(0.043)
NPL	0.183 ***	0.104	0.241 ***	0.199 ***	0.157 ***
	(0.024)	(0.076)	(0.069)	(0.037)	(0.032)
Liquidity	0.058 ***	0.009	0.048 ***	0.044 ***	0.068 ***
	(0.005)	(0.015)	(0.014)	(0.008)	(0.009)
Profitability	−0.359 ***	−0.157	−0.074	−0.374 ***	−0.374 ***
	(0.063)	(0.240)	(0.147)	(0.078)	(0.101)
Loans	−0.026 ***	−0.013 ***	−0.026 ***	−0.029 ***	−0.025 ***
	(0.017)	(0.037)	(0.039)	(0.024)	(0.025)
Market Power	−0.025 ***	−0.079	0.012	−0.021 ***	−0.031 ***
	(0.056)	(0.026)	(0.016)	(0.076)	(0.077)
Diversification	0.033	−0.036	0.0136	−0.022	0.010 ***
	(0.003)	(0.008)	(0.005)	(0.003)	(0.004)
Efficiency	−0.044 ***	−0.018	−0.031 ***	−0.035 ***	−0.051 ***
	(0.042)	(0.023)	(0.010)	(0.005)	(0.007)
Size	−0.013 ***	−0.028	−0.014 ***	−0.014 ***	−0.012 ***
	(0.022)	(0.074)	(0.046)	(0.027)	(0.035)
GDP	−0.017	−0.062 **	0.018	−0.015	−0.022
	(0.011)	(0.024)	(0.028)	(0.014)	(0.016)
Constant	0.067 ***	0.061 ***	0.072 ***	0.071 ***	0.066 **
	(0.055)	(0.019)	(0.012)	(0.073)	(0.076)
Observations	14,913	2241	1680	7361	7552
Number of id	933	141	105	461	472
AR (2)	0.793	0.499	0.282	0.854	0.898
Sargan value	0.961	0.864	0.546	0.524	0.566
Hansen value	0.969	0.848	0.551	0.543	0.691

Table 6 used a two-step GMM method to measure the impact of macroeconomic fluctuation on banks' capital buffer (ratio of tier-1 to risk-weighted assets minus 6%) adjustment for the full sample, well, adequately, and high- and low-liquid banks. If the overall risk-based capital ratio (tier I + II/total risk-weighted assets ratio) of banks is 10% or above it is well-capitalized, if the ratio is between 8 to 10% it is considered an adequately capitalized bank. Based on their median value, commercial banks are classified as highly liquid or low-liquid banks. Banks with a higher ratio of liquid assets to deposits and short-term funding than the median are treated as highly liquid banks and low-liquid banks otherwise. Robust standard errors are reported in parentheses. *** and ** represent statistical significance at 1, and 5%, respectively.

5. Conclusions

This research explores the relationship between capital buffer, nominator effect, de-nominator effect, and economic growth for large insured commercial banks of the USA. this study applied a two-step system GMM framework by using the unique and com-prehensive data set over the period extending from 2002 to 2018. The remarkable aspect of our approach is that we adopted three separate models to investigate the relationship between capital buffer, the denominator effect, the nominator effect, and economic growth in the USA. The analysis concludes the countercyclical relationship between economic

growth and capital buffer. The results indicate that, for well-capitalized banks, the effect of the countercyclical relationship is more significant than adequately capitalized banks. While using the sample as high- and low-liquid banks, the results confirm that there is a countercyclical relationship between economic growth and bank capital buffer. In the case of low-liquid banks, however, the effect is more significant than that of high-liquid banks. The findings conclude the pro-cyclical relationship between nominating impact and economic growth. The results are robust in the case of well-capitalized and high- and low-liquid banks. The findings affirm the pro-cyclical connection between the denominator effect and economic development in the United States. The findings provide valuable details on potential legislation and decision making for lawmakers, experts, politicians, and governments.

The findings have practical significance for policy consequences and future decision making. Under the following tighter capital requirement in the United States, commercial banks will refill the capital buffer requirement according to numerator plans. Therefore, alternative solutions should be found to avoid the negative impact of banks' refinancing strategies on the equity market, thus on economic growth. It is recommended to increase the capital buffer in the economic expansion period, because it is difficult for larger banks to accumulate higher capital buffer during a recession period. Although the capital buffer in the USA frequently moves as per regulators' recommendations, there is a need to monitor the large commercial banks to avoid the failure of the banking system due to the availability of capital in a crisis period.

The findings have implications for regulators while deciding the aspect of financial stability. Based on the performance of assets' composition and financing mix, there is a need to explore the connection between investments, financing, and management, which provide optimum profits along with target capital buffer.

Our results remain limited to the analysis of quantitative information for large commercial banks listed at FDIC as of 31 December 2018. Here, we are still unable to collect data for banks that are not listed at the FDIC. Future research could be conducted to study the impact of the denominator, nominator, and economic growth of the small commercial, cooperative, credit union, and saving banks by incorporating the mediating/moderating role of other economic variables and bank regulations to get better in-depth insights.

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