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FINANCIAL DEVELOPMENT AND BANK RISK-TAKING: EMPIRICAL EVIDENCE FROM THE USA

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Abstract. *This study explores the impact of financial development on the risk-taking of large commercial banks over the prolonged period from 2002 to 2019 by using a two-step system GMM method. The findings confirm that financial development has a significant and positive relationship with bank risk-taking when measured by capital ratio or Z-score. In contrast, the impact of financial development on risk is negative when measured by risk-weighted assets. The empirical results explore the idea that financial development significantly impacts the risk-taking of adequately-capitalized, under-capitalized, significantly under-capitalized, high, and low liquid banks in the USA. These findings show that the impact of financial development on banks' risk-taking was higher in the pre-crisis era than during and after the financial crisis. These results remain robust in view of different proxies and methodologies. The heterogeneous outcomes for different categories of bank in present economic conditions and in pre-, amid-, and post-crisis eras have practical implications for regulators, policymakers, investors, managers, and economists.*

Keywords*: financial development, risk-taking, capital ratio, z-score*

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1. Introduction

Financial development is a multidisciplinary term that encompasses a potentially significant framework for long-term financial and economic development (Hussain and Kumar Chakraborty 2012). It plays a vital role in the stability and growth of the banking sector (Demirgüç-Kunt and Huizinga 2000). Financial development not only increases the volume of financial services provided by financial institutions, but also significantly influences the severity of financial or economic crises. Financial development also increases the demand for funds in the financial system. Therefore, higher financial development imparts higher competition in financial markets. Higher competition eradicates abnormal profit, and encourages financial organizations toward higher risk-taking to sustain their profits.

The literature on bank risk-taking and financial performance is voluminous, but it has failed to investigate the impact of financial development, particularly in US banking from 2002 to 2019. Therefore, the partial nature of the literature in this field motivates the authors to explore the following questions regarding the impact of financial development on the risk-taking behavior of the large insured commercial banks of the USA. How does financial development influence the risk-taking behavior of large insured commercial banks in the USA? Is the relationship similar in the pre, amid, and post-crisis periods? Is the influence of financial development identical for well-capitalized, adequately capitalized, under-capitalized, significantly under-capitalized, high, and low liquid large insured commercial banks?

This study explores the influence of financial development on bank risk-taking, measured as the capitalization, risk-weighted assets, and Z-score of the large insured commercial banks in the USA from 2002 to 2019. The role of economic activities simultaneously remains significant in influencing the development, progress, and stability of financial institutions. This research is motivated by a number of recent studies, including: Shahbaz, Bhattacharya, and Mahalik 2018; Tran and Nguyen 2020; Vithessonthi 2014a; and Vithessonthi and Tongurai 2016. Currently, the relationship between financial development and bank risk-taking is an emerging debate among policymakers, researchers, decision-makers, regulators, and economists. For example, Vithessonthi's (2014a) was the first study that attempted to explore the impact of financial development on the risk-taking behavior of banks in Southeast Asian Economies. Recently, this work was extended by Tran and Nguyen (2020), who studied similar economies in Asia. Vithessonthi (2014b) also provided evidence for the influence of financial development on the risk-taking of Thai banks. However, as yet there has been no work studying the impact of financial development on the risk-taking of commercial banks in the USA. To the best of our knowledge, in the specific context of the USA, the only relevant study is from Vithessonthi and Tongurai (2016), who investigated the role of financial development on the risk-taking of 37 commercial banks in seven South American states from 1991 to 2012.

Our study contributes to the existing literature on the impact of financial development on the risk-taking behavior of commercial banks in many ways. First, this research systematically explores the impact of financial development on banks' risk-taking in the USA, which has received scant attention thus far. Second, this study examines the relationship between financial development and risk-taking in various market conditions (pre, amid, and post-crisis periods). Third, this study adds to the current literature by looking into the impact of financial development on risk-taking for well-capitalized, adequately capitalized, under-capitalized, significantly under-capitalized, high-, and low-liquid major insured commercial banks. Lastly, from a policy perspective, the empirical predictions of this study are unique because they shed light on the links between various proxies of bank risk-taking and financial development for appropriate decision-making and regulation in banking.

This study provides various insights that should be considered when dealing with the risk-taking and stability of commercial banks in the US. For example, the results confirm a significant relationship between financial development, risk-taking, and the stability of commercial banks. The impact of financial development on risk-taking is not identical across various categories of banks in the US. The results in this paper show that financial development increases the risk-taking of commercial banks when risk is measured as capital ratio. These results explore the notion that financial development is critical for adequately capitalized, under-capitalized, significantly under-capitalized, high, and low liquid major insured commercial banks. The outcomes of this paper also conclude that the impact of financial development on the risk-taking of commercial banks is not identical in pre-, amid, and post-crisis eras.

This study is organized as follows: the subsequent Section briefly discusses surrounding literature and the development of the hypotheses; the third Section contains the data and the econometric model; the fourth Part consists of the discussion of results; and the final Section provides conclusions and policy recommendations.

2. Review of Literature

2.1. Theoretical Framework

Theories linking bank risk-taking to economic indicators are not scarce in the banking literature. Banking literature studying the correlation between macroeconomic activities and their basis in the financial system goes back to the theories presented by Bernanke, Gertler, and Gilchrist (1998), and King and Plosser (1982). Pesaran, Schuermann, Treutler, and Weiner (2006), for example, presented a model that linked the business cycle and the credit portfolios of banks. The countercyclical hypothesis suggests that banks take on higher risk in poor economic conditions to sustain their returns, whereas the pro-cyclical hypothesis suggests that banks take on higher risk in good economic conditions (Jokipii and Milne 2008). Rapid growth in the financial system motivates financial institutions to take on higher risk at a lower capital basis, which is in line with the moral hazard hypothesis (Espenlaub, Khurshed, and Sitthipongpanich 2012). Higher financial

development increases the competition among firms to sustain their market value, in line with the financial fragility hypothesis and the financial stability hypothesis in banking (Beck 2008; Marcus 1984). In boom economic conditions, the regulatory hypothesis suggests that financial firms increase their capital base with increased risk (Shrieves and Dahl 1992). Finally, yet importantly, through various channels, the agency theory always remains critical in financial literature. Higher risk-taking may become beneficial for management in the shape of higher compensation in terms of wages, and for shareholders in terms of higher returns.

2.2. Hypotheses Development

Financial development has a positive influence on economic activities (Guiso, Sapienza, and Zingales 2004; Ndikumana 2005); simultaneously, it increases the risk-taking of financial institutions. Because financial development creates demand for loans and financial institutions lend more to earn higher profits, the risk of financial firms is increased (Foos, Norden, and Weber 2010). Gimet and Lagoarde-Segot (2012) argue in their study that a boost in the stock market increases the demand for loans, which lead banks to take higher risks. Theoretically, the idea of a positive relationship between financial development and bank risk-taking is in line with the competition fragility hypothesis (Beck 2008; Marcus 1984). Conversely, higher financial development may decrease a financial institutions' risk-taking (Vithessonthi and Tongurai 2016). This notion is consistent with the argument of Vithessonthi and Tongurai (2016), who suggest that when financial markets further develop commercial banks face higher competition, which increases the risk-taking of banks seeking to achieve higher profits. In the case of increased financial development, more opportunities are created for investors to secure higher profits that improve the repaying ability of investors to financial institutions. This suggests that an increase in financial development decreases the default risk of commercial banks.

Moreover, financial development influences risk-taking arising from bank lending. Therefore, this phenomenon is significant for policymakers and regulators in understanding the effect of financial development on bank risk-taking. A workaround towards regulation that incorporates the impact of financial development and commercial bank risk-taking is lacking. The existing literature provides evidence that the growth of financial markets and other economic activities contributes to the stability, progress, and development of the financial system. The relationship between economic activities and financial institutions is obvious, and is mandatory in propagating the economic cycle (Hussain and Kumar Chakraborty 2012). The literature supports the positive effect of financial development on economic activities (Levine and Zervos 1998; Merton 1995). Fundamentally, the development of financial markets affects the efficiency of financial services, the distribution of funds, risk management, and the economical flow of money. Improvements in the financial system (e.g., improvements in bank guidelines) may also affect how banks operate and behave. These improvements can have either a positive or a detrimental effect on the soundness of the financial structure and the stability of the monetary framework (Vithessonthi and Tongurai 2016). Theoretically,

financial development may positively or negatively influence the risk-taking of commercial banks. The empirical literature provides evidence that financial development creates opportunities to efficiently allocate funds and to optimize investment portfolios at lower risk (Beck 2008; Law, Tan, and Azman-Saini 2015).

Tran and Nguyen (2020) examined the impact of financial market development on risk-taking in six Southeast Asian economies. Their study concluded that the effect of financial development on the Z-score index was positive and significant, and that the impact of financial development was negative on non-performing loans. Vithessonthi (2014a) explored the influence of financial development on the risk-taking of banks in Asian countries. Their study found that an increase in financial development increased the risk-taking of banks. Vithessonthi (2014b) also conducted a study in Thailand, which confirmed that there was a negative and significant relationship between stock market development and bank risk-taking. This study also suggested that an increase in financial market development decreased the risk-taking of Thai banks. Despite the gainful impacts of financial development on the risk-taking of banks, there has been limited exploration of its conceivable detrimental impacts on banks and financial frameworks. In light of the ambiguous and inconclusive nature of the surrounding literature, we have developed the following hypothesis:

Hypothesis 1: Financial development positively affects the risk-taking of large commercial banks in the USA.

Bikker and Metzemakers (2005) provided evidence to suggest that economic activities/business cycles significantly influence bank risk-taking. According to their findings, banks lend more in expansionary economic conditions and decrease lending during contractionary economic conditions. Their study also documented banks experiencing an abnormal rise in non-performing loans under weak economic conditions (such as the financial crisis). To extend the debate surrounding economic activities to their influence on the risk-taking of commercial banks, Abbas and Masood (2020) concluded that the adjustment of bank capital ratios was not similar in pre, amid, and post-crisis eras. Claessens, Kose, and Terrones (2012) discussed and compared the business cycle and bank risk-taking in emerging and developed economies. They concluded that the impact of the business recession on decreasing output was doubled in emerging economies compared to in developed countries. Abbas, Ali, and Rubbaniy (2021) documented that the speed of regulatory capital ratio adjustment varies across different market conditions (pre, amid, and post-crisis periods). Williams and Nguyen (2005) argued that financial liberalization in Southeast Asian economies boosts the performance of commercial banks. Espenlaub et al. (2012) provided evidence in favor of moral hazard issues due to financial reforms in Asian countries after the financial crisis.

Hypothesis 2: The impact of financial development on banks' risk-taking varies with market conditions (pre, amid, and post-crisis periods).

Abbas, Batool, and Sulehri (2020) recently investigated the impact of trade, investment, and financial freedom on the risk-taking of well-capitalized, under-capitalized, high, and low liquid US banks. Their study concluded that their findings were not identical for all categories of banks. Abbas, Yousaf, Ali, and Wong (2021) investigated the

role of economic growth on risk-taking and bank capital ratios based on the characteristics of banks regarding liquidity and capitalization. Their study explored heterogeneous findings for well-capitalized, under-capitalized, high, and low liquid banks in the US. Vithessonthi and Tongurai (2016) conducted a study in South America to assess the impact of financial development on risk-taking, and in their analysis proved that financial market development boosts bank capitalization and decreases the dependence of banks on non-traditional banking activities. Their study concluded that financial development, on average, reduces bank risk-taking. Abbas and Masood (2020) concluded in their study that the adjustment of well-capitalized, under-capitalized, high, and low-liquid banks is not similar. Abdul Hamid, Azmi, and Ali (2020) explored the impact of financial development on bank capitalization, noting that it is not similar between Islamic and conventional banks. Abbas and Ali (2020) reported on the differences between state-charter member and non-member banks in their study. In light of the ambiguous and inconclusive nature of the literature, we have developed the following hypothesis:

Hypothesis 3: The impact of financial development on risk-taking varies across the characteristics of banks.

3. Data and Methodology

3.1 Data and Sample Selection

To obtain results on how financial development influences the risk-taking of major US commercial banks, bank-specific data for 2002–2019 were collected from the balance sheets and the income statements of commercial banks available at the Federal Deposit Insurance Corporation (FDIC).[1] The data for financial development indicators, trade openness, real gross domestic products, and inflation rate were taken from the World Bank[2] indicators database. The study sample comprises US-insured commercial banks as defined in FDIC reports and, further, involves assets on a consolidated basis. In nearly 1806, several banks were listed as on dated 31 December 2019.[3] For definitions of variables and details of proxy measurement, see Table 1.

Nevertheless, for sufficient and reliable data analysis, the criteria for inclusion into the study sample were as follows: on the stated date, the status of the listed bank must be active; there must be no missing data for dependent variables for any period; and the bank's assets must total at least $300 million as of 31 December 2019. After filtering based on the above parameters, 945 banks were selected for the study. If the overall risk-based capital ratio of a bank was 10% or above, it was characterized as well-capitalized, if the ratio was between 8% and 10% it was graded as adequately-capitalized, and if the ratio was less than 8% it was considered under-capitalized. This study also classified the sample into high- and low-liquid banks based on the average liquidity ratio.

1 https://www7.fdic.gov/idasp/advSearchLanding.asp
2 https://data.worldbank.org/indicator
3 https://www.federalreserve.gov/releases/lbr/current/

Table 1. *Variables measurement*

Variables Names	Measurements
Capital ratio	Total equity/Total assets (Abbas, Rubbaniy and Ali 2021; Tongurai and Vithessonthi 2020)
Risk-based capital ratio	Tier-I plus Tier-II/risk-weighted assets (Vithessonthi 2014b)
Bank Risk-taking (RWA)	Risk-weighted assets/total assets (Abbas and Masood 2020)
Z-score Index	Equity/ta Plus ROA/σ of ROA (Jiang, Levine, and Lin 2017; Tran and Nguyen 2020)
Financial Development (SMC)	Market Capitalization to GDP ratio (Abdul Hamid et al. 2020)
Financial Development (DCB)	Domestic credit to the private sector by banks to GDP ratio (Abdul Hamid et al. 2020)
Financial Development (BSD)	Banking industry assets to GDP ratio (Demirgüç-Kunt and Huizinga 2000)
Liquidity	Liquid assets/total assets (Yousaf, Ali and Hassan 2019a)
Profitability	Net income/total assets (Yagli 2020)
Loans ratio	Net loans/total assets (Ali, Shah and Chughtai 2019)
Deposits ratio	Deposits/total assets (Vithessonthi 2014b)
Bank size	Natural log of total assets (Yousaf, Ali and Hassan 2019b)
Business trend	Real gross demotic product (Tran and Nguyen 2020)
Trade Openness	Import plus exports/GDP ratio (Tran and Nguyen 2020)
Inflation rate	Consumer Price Index

3.2 Econometric Model

The primary purpose of this study is to highlight the impact of financial development on bank risk-taking. This econometric relationship can be shown in the following equations:

$$Y_{i,t} = \alpha + \beta_1 X_{i,t} + \beta_2 Z_{i,t} + \eta_t + \upsilon_t + \varepsilon_{i,t} \quad (1)$$

Here, Y represents the dependent variable of risk-taking (bank capitalization, RWA, and Z-score index), α is a constant, i is a cross-section which is a bank, t is time in the form of a year, X represents the independent variable of financial development (DCB, SMC, and BSD), Z represents control variables that include liquidity, profitability, loan growth, deposit ratio, bank size, trade openness, real gross domestic product, and inflation rate. The symbol represents bank-fixed effects, represents period-fixed effects, and

represents the zero-mean disturbance term. The above equation (1) represents the static form of the regression model. The results of a static econometric model of linear regression do not incorporate various issues of autocorrelation, heteroscedasticity of model parameters, or data simultaneity, and hence lead to a biased result. In order to avoid issues of endogeneity (mainly taken as the correlation of several explanatory variables with their error terms in the respective model) and a dependence on lagged information from such endogenous variables, this study demonstrates a dynamic panel dataset methodology for the estimation of unbiased, precise, and consistent estimators (Arellano and Bond 1991; Roodman 2009; Vithessonthi and Tongurai 2016). Further, the widely used technique of the two-step linear GMM estimator model is used in the analysis, as it is considered to be more suitable and reliable than the panel estimators described in one-step GMM linear models (Windmeijer (2005). The model equation below shows the dynamic nature of the two-step panel dataset approach:

$$Y_{i,t} = \alpha + \beta_1 Y_{i,t-1} + \beta_2 X_{i,t} + \beta_3 Z_{i,t} + \varepsilon_{i,t} \quad (2)$$

Here, represents the lagged values of dependent variables in bank risk-taking. The coefficient concerning the economic variables of the study exerts a short-term impact on a bank's risk-taking exposure in the econometric models described above. This study highlights the influence of financial development on the bank's risk-taking conditions for the three proxies of pre-crisis, amid-crisis, and post-crisis periods. The following model equation shows the inclusion of dummies () of explanatory variables for the description of the crisis period:

$$Y_{i,t} = \alpha + \beta_1 Y_{i,t-1} + \beta_2 X_{i,t} + \beta_3 TD_{i,t} + \beta_4 Z_{i,t} + \varepsilon_{i,t} \quad (3)$$

4. Empirical Analysis

4.1 Descriptive Statistics

Table 2 contains information on the proxies used to investigate the impact of financial development on risk-taking. The statistics indicate that the average ratio of capital was 10.2%, with a standard deviation of 1.8%. The average percentage of risk-weighted assets was 72.5%, with a standard deviation of 11%. The average financial development (SMC) was 7.8%, with a standard deviation of 0.8%. The mean value of financial development (DCB) was 53%, with a standard deviation of 3%. No abnormality was found in the descriptive statistics, and these values are in line with previous studies in a similar context.

Table 2. *Descriptive statistics*

Variable	Obs	Mean	Std. dev.	Min	Max
Risk-based capital	16,065	0.141	0.027	0.024	0.275
Capital	16,065	0.102	0.018	0.065	0.173
Risk-taking (RWA)	16,065	0.725	0.110	0.360	1.154
Z-score index	16,065	0.269	0.173	−0.125	0.720
Financial Development (SMC)	16,065	0.078	0.008	0.061	0.088
Financial development (DCB)	16,065	0.530	0.030	0.494	0.598
Financial development (BSD)	16,065	0.137	0.027	0.097	0.184
Liquidity	16,065	0.048	0.027	−0.054	0.156
Profitability	16,065	0.009	0.005	−0.051	0.027
Loans	16,065	0.714	0.148	0.044	1.185
Deposits	16,065	0.139	0.271	−0.171	2.909
Size	16,065	13.58	0.950	12.259	15.538
Trade openness	16,065	0.154	0.012	0.130	0.174
Business trend	16,065	0.020	0.014	−0.025	0.038
Inflation rate	16,065	1.934	0.649	0.759	3.218

Source: *authors' calculation using Stata.*

Table 3. *Pairwise correlations*

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Capital	1												
RWA	0.039*	1											
Z-score index	0.163*	-0.107*	1										
SMC	-0.064*	0.038*	-0.005	1									
DCB	-0.130*	0.121*	-0.030*	0.144*	1								
Liquidity	0.036*	-0.150*	-0.081*	-0.176*	-0.207*	1							
Profitability	0.062*	0.026*	0.105*	0.253*	0.012	-0.074*	1						
Loan	-0.084*	0.648*	-0.109*	0.090*	0.148*	-0.151*	0.034*	1					
Deposit	0.010	0.019*	0.071*	-0.004	-0.005	0.032*	0.025*	-0.073*	1				
Size	0.134*	0.112*	0.133*	-0.109*	-0.096*	-0.064*	-0.040*	-0.038*	0.101*	1			
Trade openness	0.070*	-0.009	0.021*	-0.140*	0.253*	0.042*	0.001	-0.011	0.001	0.086*	1		
Business trend	0.018*	-0.011	0.012	0.638*	-0.211*	-0.061*	0.166*	0.005	-0.000	-0.024*	0.062*	1	
Inflation	-0.097*	0.035*	-0.018*	0.543*	0.465*	-0.193*	0.132*	0.083*	-0.005	-0.127*	0.277*	0.546*	1

* shows significance at the .05 level. Here, due to issues of space, we use the following acronyms for financial development: stock market development (SMC), domestic credit provided by banks to the private sector (DCB), and risk-weighted assets to total assets (RWA).

Table 3 reports the correlation results among the proxies used in the analysis. These findings confirm that there was no problem with the high correlation between explanatory variables. Moreover, it was also found that the relationship among variables was as per

the economic theory. The low correlation between explanatory variables also indicated that there was no problem with high multicollinearity. The findings of the correlation matrix are in line with those of previous studies.

4.2 Base model results for the full sample of banks

Table 4. *The results of the impact of financial development on bank risk-taking for the full sample of banks*

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Capital ratio	RWA	Z-Score	Capital ratio	RWA	Z-Score
Lagged risk-taking	0.805***	0.797***	0.960***	0.791***	0.833***	0.996***
	(0.040)	(0.030)	(0.034)	(0.042)	(0.030)	(0.031)
SMC	−0.089**	−1.188***	0.998***			
	(0.035)	(0.369)	(0.259)			
DCB				−0.017**	−0.146***	0.237***
				(0.007)	(0.044)	(0.059)
Liquidity	−0.014***	−0.509***	−0.030*	−0.014***	−0.504***	−0.008
	(0.004)	(0.022)	(0.016)	(0.004)	(0.021)	(0.017)
Profitability	0.281***	0.661***		0.269***	0.492***	
	(0.026)	(0.130)		(0.024)	(0.100)	
Loans	−0.009***	0.082***	−0.031***	−0.009***	0.067***	−0.029***
	(0.001)	(0.014)	(0.004)	(0.001)	(0.013)	(0.004)
Deposits	−0.001	0.004**	0.001	−0.001	0.003*	−0.001
	(0.000)	(0.002)	(0.002)	(0.000)	(0.002)	(0.001)
Size	0.001***	−0.001*	0.001	0.001***	−0.002***	0.001
	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Business trend	0.004	0.520***	−0.169**	−0.028***	0.166***	0.222***
	(0.010)	(0.088)	(0.068)	(0.009)	(0.050)	(0.044)
Trade openness	0.001***	0.001***	−0.001	0.001***	0.001***	−0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Inflation	0.001**	0.002	−0.003***	0.001**	0.001	−0.005***
	(0.000)	(0.002)	(0.001)	(0.000)	(0.001)	(0.001)
Constant	0.020***	0.181***	−0.043**	0.024***	0.169***	−0.100***
	(0.005)	(0.028)	(0.019)	(0.006)	(0.024)	(0.032)
Observations	16,065	16,065	16,065	16,065	16,065	16,065
Number of id	945	945	945	945	945	945
No. of instruments	12	12	11	12	12	11
AR (2)	0.188	0.069	0.729	0.183	0.159	0.578
Hansen values	0.102	0.304	0.169	0.094	0.366	0.422

Robust standard errors are reported in parenthesis (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$)

Table 4 contains the findings of a two-step GMM system framework. Table 4, column 1, reports the impact of stock market capitalization (SMC) on bank capitalization. These findings reject hypothesis 1 of the study. The results show that SMC and domestic credit provided by banks to the private sector (DCB) increase the risk-taking of commercial banks by lowering their capitalization, which is in line with the moral hazard hypothesis (Jacques and Nigro 1997)1997. The negative relationship between bank capitalization and the business cycle is also consistent with the findings of other authors (Ayuso, Pérez, and Saurina 2004; Lindquist 2004; Stolz and Wedow 2011), and contradicts (Abdul Hamid et al. 2020; Vithessonthi 2014b). In line with the findings of other authors, (Williams and Nguyen 2005) financial development decreases risk-taking by reducing investment in risk-weighted assets. However, SMC and DCB are better for the stability of large commercial banks.

These findings show a negative and statistically significant relationship between SMC and bank capitalization. The negative impact of SMC indicates that an increase in stock market business tends to decrease bank capitalization. Because of the rise in SMC, the demand for loans increases, boosting risk-taking behavior among banks. This argument is in line with the hypothesis of competition fragility in banking. Table 4, column 2 contains the results for the impact of SMC on bank risk-taking when measuring the ratio of risk-weighted assets to total assets. These findings reveal that there is a negative relationship between bank risk-taking and SMC. Development in the stock market decreases the investment of commercial banks in risky assets as it motivates banks to invest in the stock market, which represents a better opportunity than lending to risky borrowers. SMC reduces the dependence of commercial banks on investing in risky assets, because SMC provides opportunities to invest in the stock market and attain higher profits at a lower risk than risky assets in a shorter period. In banking literature, this justification is consistent with the competition stability hypothesis. The third proxy of bank risk-taking is the Z-score index. The results of Table 4, column 3, provide robust evidence in favor of the competition stability hypothesis. These findings allow us to explore the idea that a positive change in SMC contributes to stabilizing commercial banks in the USA. According to our empirical predictions, stock market development is favorable for the stability of the financial system in the USA.

The second proxy of financial development is DCB. This proxy is more specific to banking operations than the measurement of SMC. Table 4, columns 4, 5, and 6, contain the impact of DCB on bank capitalization, ratio of risk-weighted assets to total assets, and Z-score index. Surprisingly, concerning the sign and significance, these findings are in line with the proxy of SMC. The impact of DCB on bank capitalization and risk-weighted asset ratio is significant and negative.

On the contrary, the impact on Z-score is significant and positive. These findings confirm that financial development increases the stability of commercial banks. The role of the control variables is significant and in line with the outcomes of prior studies (Abdul Hamid et al. 2020; Tran and Nguyen 2020; Vithessonthi 2014b; Vithessonthi and Tongurai 2016) which have concluded, for example, that profitability has a positive and significant influence on bank capitalization and risk-weighted asset ratio. The roles of liquidity, bank size, loan ratio, business trend, trade openness, and the inflation rate are

decisive and significant. The sign and significance of control variables remained consistent throughout this analysis.

Table 5. *The results of the impact of financial development on bank risk-taking for well-capitalized, adequately capitalized, under-capitalized, and significantly under-capitalized banks*

	(1)	(2)	(3)	(4)	(5)	(6)
Panel-A: Well-capitalized banks						
VARIABLES	Capital ratio	RWA	Z-Score	Capital ratio	RWA	Z-Score
Lagged risk-taking	0.769***	1.016***	0.850***	0.671***	0.848***	0.738***
	(0.057)	(0.100)	(0.087)	(0.070)	(0.068)	(0.110)
SMC	−0.259**	−2.075**	−0.959			
	(0.126)	(0.897)	(1.035)			
DCB				−0.018	−0.595***	0.494
				(0.032)	(0.179)	(0.446)
Panel-B: Adequately-capitalized banks						
Lagged risk-taking	0.797***	0.841***	0.717***	0.504***	0.870***	0.959***
	(0.127)	(0.122)	(0.138)	(0.061)	(0.081)	(0.213)
SMC	−0.212***	1.279**	3.220***			
	(0.062)	(0.498)	(0.943)			
DCB				−0.022*	−0.058	0.179**
				(0.013)	(0.183)	(0.084)
Panel-C: Under-capitalized banks						
Lagged risk-taking	0.803***	0.770***	0.925***	0.805***	0.816***	0.922***
	(0.056)	(0.039)	(0.039)	(0.056)	(0.037)	(0.040)
SMC	−0.217***	−1.233*	0.967***			
	(0.080)	(0.704)	(0.328)			
DCB				−0.045**	−0.157*	0.235***
				(0.020)	(0.087)	(0.080)
Panel-D: Significantly Under-capitalized banks						
Lagged risk-taking	0.819***	0.740***	0.847***	0.831***	0.596***	0.846***
	(0.029)	(0.033)	(0.038)	(0.031)	(0.042)	(0.037)
SMC	−0.295***	0.474**	0.619***			
	(0.050)	(0.199)	(0.170)			
DCB				0.133***	0.182***	−0.228**
				(0.024)	(0.036)	(0.094)

Robust standard errors are reported in parenthesis (*** p < 0.01, ** p < 0.05, * p < 0.1)

Table 5 reports the results for well, adequately, under, and significantly under-capitalized large commercial banks. Table 5, Panel-A contains the results for well-capitalized banks. These findings confirm that an increase in financial development decreases the risk of well-capitalized banks when risk is measured by risk-weighted assets, whereas it i

ncreases the risk when measured by bank capital ratio findings that are in line with those of other scholars (Ayuso et al. 2004; Espenlaub et al. 2012). On the contrary, the relationships between financial development, bank capitalization, and the Z-score index are insignificant. In the interpretation of the authors, well-capitalized banks are already at their optimal business level, as a result of which financial development has no impact on their operations. Table 5, Panel-B, columns 1 to 6 consist of the findings of adequately-capitalized banks. This empirical output shows that financial development increases the risk-taking of adequately-capitalized banks by lowering bank capitalization (Lindquist 2004; Stolz and Wedow 2011) and increasing risk-weighted assets. However, positive changes in SMC and DCB increase the stability of adequately capitalized banks. Table 5, Panel-C, columns 1 to 6 report the findings of under-capitalized banks. These empirical results show that these findings are in line with the baseline model. Financial development increases the risk-taking of under-capitalized banks by lowering capitalization (Espenlaub et al. 2012; Stolz and Wedow 2011), and decreases risk-taking by reducing investment in risk-weighted assets and contributing to the stability of under-capitalized banks (Williams and Nguyen 2005). These results remain robust for under-capitalized banks in view of SMC and DCB. Table 5, Panel-D contains the findings for significantly under-capitalized large commercial banks. These results show that SMC increases the risk-taking of significantly under-capitalized banks by lowering capitalization and increasing investment in risk-weighted assets. However, SMC is better for the stability of significantly under-capitalized banks.

On the other hand, an increase in DCB has a positive impact on bank capitalization and an increase in risk-weighted assets. According to the banking literature, this argument aligns with the regulatory hypothesis (Ding and Sickles 2018; Jokipii and Milne 2011; Shrieves and Dahl 1992). However, excessive credit to the private sector has a negative impact on the stability of significantly under-capitalized banks.

Table 6. *The impact of financial development on bank risk-taking – results for high and low-liquid banks*

	(1)	(2)	(3)	(4)	(5)	(6)
Panel-A: High-Liquid Banks						
VARIABLES	Capital ratio	RWA	Z-Score	Capital ratio	RWA	Z-Score
Lagged risk-taking	0.748***	0.932***	0.808***	0.676***	0.938***	0.839***
	(0.037)	(0.052)	(0.061)	(0.033)	(0.051)	(0.061)
SMC	−0.203***	−0.440*	1.254***			
	(0.027)	(0.246)	(0.462)			
DCB				−0.019***	−0.089**	0.182***
				(0.006)	(0.039)	(0.037)
Constant	0.042***	0.058**	−0.068*	0.047***	0.072***	−0.072**
	(0.006)	(0.025)	(0.039)	(0.007)	(0.026)	(0.033)
AR (2)	0.657	0.086	0.236	0.654	0.110	0.177
Hansen value	0.567	0.302	0.936	0.773	0.562	0.068
Panel-B: Low-Liquid banks						

	(1)	(2)	(3)	(4)	(5)	(6)
Lagged risk-taking	0.776***	0.779***	0.904***	0.737***	0.668***	0.907***
	(0.041)	(0.035)	(0.023)	(0.044)	(0.048)	(0.022)
SMC	–0.674***	0.390	0.589***			
	(0.112)	(0.403)	(0.165)			
DCB				–0.203***	0.122***	0.120***
				(0.042)	(0.034)	(0.031)
Constant	0.062***	0.157***	0.001	0.122***	0.132***	–0.019
	(0.008)	(0.029)	(0.018)	(0.022)	(0.029)	(0.021)
AR (2)	0.436	0.826	0.435	0.137	0.598	0.504
Hansen value	687	0.637	0.165	0.123	0.119	0.317

Robust standard errors are reported in parenthesis (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$)

Table 6 contains the results for high and low liquid large commercial banks by using two-step GMM methods. In Table 6, Panel-A and Panel-B report the results for the impact of SMC on the risk-taking of high and low-liquid large commercial banks, respectively. Consistent with our baseline predictions, financial development increases the risk-taking of high and low-liquid large commercial banks by lowering capitalization, in line with other studies (Espenlaub et al. 2012). However, the impact of SMC is more significant in influencing low liquid than high-liquidity large commercial banks. These findings confirm that the effect of SMC is weak in reducing the risk-weighted assets of high-liquid banks.

In contrast, the coefficient of SMC is positive but insignificant in influencing the risk-weighted assets of low-liquid banks. The above results show that SMC is beneficial for the stability of commercial banks. However, SMC more significantly influences the stability of high liquid than low-liquid commercial banks. Table 6, Panel-A, columns 4 to 6 and Table 6, Panel-B, columns 4 to 6 report the results of the impact of DCB on the risk-taking of high and low-liquid large commercial banks, respectively. These findings show that an increase in the credit supplied to the private sector increases the risk-taking of high-liquid banks by lowering capitalization (Espenlaub et al. 2012; Lindquist 2004).

In contrast, an increase in DCB decreases risky assets (Williams and Nguyen 2005). These findings are different for low-liquid banks. For example, financial development increases low-liquid banks' risk-taking by lowering capitalization ratios and increasing investment in risk-weighted assets. This argument is in line with the moral hazard hypothesis in banking. However, financial development, when measured as DCB, is beneficial for the stability of high- and low-liquid large commercial banks.

4.3 The results of the pre, amid, and post-crisis periods

Table 7. *The impact of financial development on bank risk-taking results for the pre, amid, and post-crisis periods*

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Capital ratio	RWA	Z-Score	Capital ratio	RWA	Z-Score
Lagged risk-taking	0.763***	0.814***	0.892***	0.831***	0.842***	0.822***
	(0.028)	(0.034)	(0.025)	(0.050)	(0.035)	(0.030)
SMC	−0.076**	0.929***	0.671***			
	(0.033)	(0.155)	(0.157)			
SMC*BCD	−0.072***	0.452***	0.243**			
	(0.012)	(0.064)	(0.103)			
SMC*DCD	−0.048***	0.265***	0.166**			
	(0.010)	(0.049)	(0.074)			
DCB				0.150***	−0.354***	0.270***
				(0.055)	(0.055)	(0.041)
DCB*BCD				−0.050***	0.104***	−0.057***
				(0.013)	(0.010)	(0.008)
DCB*DCD				−0.050***	0.101***	−0.060***
				(0.014)	(0.010)	(0.008)
Constant	0.031***	−0.018	−0.047**	−0.019	0.165***	−0.048**
	(0.003)	(0.018)	(0.019)	(0.019)	(0.023)	(0.023)
Observations	16,065	16,065	16,065	16,065	16,065	16,065
Number of id	945	945	945	945	945	945
No. of instruments	18	18	14	14	18	17
AR (2)	0.223	0.172	0.767	0.390	0.203	0.711
Hansen value	0.559	0.905	0.239	0.613	0.109	0.474

Robust standard errors are reported in parenthesis (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$). Here an interactive term (SMC*BCD) represents a pre-crisis dummy; SMC*DCD is during crisis dummy. For the second proxy, DCB*BCD is a pre-crisis dummy, and DCB*DCD represents during crisis dummy.

Table 7, columns 1 to 6 contain the comparative findings for the pre, amid, and post-crisis periods using the two-step GMM method. Columns 1 to 3 report the effect of SMC on risk-taking for the pre (2002–2006), amid (2007–2010), and post-crisis (2010–2019) periods of large commercial banks in the USA. These findings show that SMC increases the risk-taking of large commercial banks by lowering capitalization (Abdul Hamid et al. 2020; Ayuso et al. 2004; Espenlaub et al. 2012). This impact on increasing the risk-taking of commercial banks remains higher in the pre-crisis period than during the peri-crisis and post-crisis periods. Theoretically, it is more difficult for commercial banks to boost their capitalization in a period of crisis than in normal economic conditions.

Table 7, column 2 contains the findings for the effect of SMC on the risk-weighted assets of banks. SMC increases the investment of commercial banks in risk-weighted assets. However, this impact is more significant before and during a crisis than in the post-crisis era. The positive relationship between stock market capitalization and Z-score indicates that financial development is beneficial for bank stability. These empirical results prove that the impact of SMC remains more significant before and during the crisis period than in the post-crisis era. Columns 4 to 6 contain results on the effect of DCB on the risk-taking of large commercial banks. Positive change in domestic credit reduces the risk-taking of commercial banks, and this impact remains consistent in the pre-crisis and peri-crisis periods. This effect of influencing the capitalization of commercial banks is more significant in the post-crisis period than in the pre- and peri-crisis periods. The development of domestic credit decreases the investment of commercial banks in risky assets, and remains beneficial for the stability of banks.

4.4 Robustness checks

Table 8 contains the results of the effect of financial development (stock market capitalization and domestic credit provided by banks to the private sector) on the risk-taking of large commercial banks. For the robustness check, we replaced the total equity to total assets ratio of capitalization with tier-I and tier-II capital to risk-weighted asset ratio. Risk-based capital ratio is a more conservative measure of bank capitalization than the traditional leverage ratio, because risk-based capital ratio is directly aligned with the risk-taking of commercial banks. Table 8, columns 1 to 5 report the results for the full sample of banks: well-, under-capitalized, high-, and low-liquidity large commercial banks, respectively. In line with our baseline model results, these findings show that financial development – either measured in stock market capitalization or domestic credit provided by banks to private sectors – increases risk-taking by lowering capital ratios. There is a negative relationship between risk-based capital ratio and financial development (DCB – Table 8 Panel-A, and SMC – Table 8 Panel-B). These findings are robust for the overall sample of well-, under-capitalized, high-, and low- liquidity large commercial banks in the USA.

Table 8. *The results of the robustness of the impact of financial development on bank risk-taking*

	Overall sample	**Well-capitalized**	**Under-capitalized**	**High-liquidity**	**Low-liquidity**
Panel: A the Effect of Domestic Credit Provided by Banks to Private Sectors on Risk-taking					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
VARIABLES	Capitalization	Capitalization	Capitalization	Capitalization	Capitalization
Lagged risk-taking	0.637***	0.670***	0.735***	0.680***	0.567***
	(0.029)	(0.060)	(0.050)	(0.036)	(0.045)
DCB	−0.091***	−0.077**	−0.144***	−0.089***	−0.100***
	(0.010)	(0.031)	(0.021)	(0.014)	(0.014)

	(1)	(2)	(3)	(4)	(5)
Panel-B: The Effect of Stock Market Development on Risk-taking					
Lagged risk-taking	0.642***	0.672***	0.675***	0.667***	0.609***
	(0.035)	(0.063)	(0.042)	(0.042)	(0.058)
SMC	−0.858***	−0.533***	−0.686***	−0.656***	−0.855***
	(0.131)	(0.264)	(0.135)	(0.100)	(0.129)
Constant	0.140***	0.105***	0.148***	0.144***	0.140***
	(0.010)	(0.024)	(0.017)	(0.014)	(0.013)
Observations	16,065	2,482	4,265	7,973	8,092
Number of id	945	146	251	469	476
No. of instruments	15	15	15	15	15
AR (2)	0.602	0.684	0.517	0.944	0.518
Hansen value	0.771	0.666	0.686	0.946	0.912

Robust standard errors are reported in parenthesis (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$)

For the robustness check, we also used an alternative proxy of financial development mainly linked with the banking industry – the measure of banking industry assets to gross domestic product ratio (BSD). Table 9 reports the findings for the impact of financial development on the risk-taking of large commercial banks as shown in banking industry assets to gross domestic product. Table 9, Panel-A contains results for the effect of financial development (BSD) on the bank capitalization of the overall sample of well-, adequately-, under-, significantly under-capitalized, high-, and low-liquidity large commercial banks. These outcomes confirm that the development of the banking industry increases risk-taking by lowering the capitalization of banks. These findings are robust alongside the baseline model results, and remain robust for the overall sample of well-, adequately-, under-, significantly under-capitalized, high-, and low-liquidity large commercial banks. Table 9, Panel-B contains the outputs for the impact of financial development on risk-weighted assets. These results show a negative relationship between the development of the banking industry and the risk-weighted assets of large commercial banks. These findings are in line with the baseline model, except for under-capitalized and low-liquidity banks. Table 9, Panel-C reports the impact of financial development (BSD) on the Z-score of large commercial banks. It was found that an increase in industry assets decreases the level of stability of large commercial banks, which is not robust alongside the baseline model. However, it could be argued that an increase in assets may lead to an inflationary boost that remains harmful for the stability of banks.

Table 9. *The results of the robustness of the impact of financial development on bank risk-taking*

	Overall sample	Well-capitalized	Adequately-capitalized	Under-capitalized	Sig. under-capitalized	High-liquid	Low-liquid
Panel-A: Effect of Banking Sector Development on Capitalization							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	Capitalization	Capitalization	Capitalization	Capitalization	Capitalization	Capitalization	Capitalization
Lagged risk-taking	0.785***	0.702***	0.593***	0.839***	0.853***	0.793***	0.756***
	(0.027)	(0.070)	(0.078)	(0.056)	(0.032)	(0.034)	(0.041)
BSD	−0.146***	−0.122*	0.014	−0.135***	−0.166***	−0.024	−0.141***
	(0.024)	(0.071)	(0.059)	(0.044)	(0.029)	(0.023)	(0.027)
Panel-B: Effect of Banking Sector Development on Risk-weighted Assets							
	RWA	RWA	RWA	RWA	RWA	RWA	RWA
Lagged risk-taking	0.770***	0.836***	0.721***	0.951***	0.896***	0.874***	0.812***
	(0.046)	(0.123)	(0.136)	(0.056)	(0.072)	(0.086)	(0.047)
BSD	−0.265**	−0.700*	−0.042	−0.041	0.835***	−0.228	0.103
	(0.122)	(0.417)	(0.460)	(0.191)	(0.316)	(0.245)	(0.158)
Panel-C: Effect of Banking Sector Development on Z-score Index							
	Z-score	Z-score	Z-score	Z-score	Z-score	Z-score	Z-score
Lagged risk-taking	0.803***	0.710***	0.667***	0.904***	0.815***	0.761***	0.854***
	(0.034)	(0.079)	(0.222)	(0.041)	(0.039)	(0.062)	(0.026)
BSD	−0.490***	−0.698**	0.109	−0.407**	−0.646***	−0.313**	−0.584***
	(0.097)	(0.300)	(0.327)	(0.199)	(0.148)	(0.148)	(0.111)
Constant	0.049***	0.054***	0.044**	0.043***	0.042***	0.027***	0.052***
	(0.007)	(0.018)	(0.018)	(0.012)	(0.008)	(0.007)	(0.007)
Observations	16,065	2,482	1,819	4,265	7,412	7,973	8,092
Number of id	945	146	107	251	436	469	476
No. of instruments	12	12	13	13	13	14	13
AR (2)	0.287	0.765	0.069	0.343	0.762	0.510	0.244
Hansen value	0.165	0.315	0.565	0.559	0.135	0.054	0.084

Robust standard errors are reported in parentheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$)

In Appendix 1, an alternative econometric technique to validate the study predictions is outlined. In the appendices, Table 10 contains the results of the impact of financial development on bank risk-taking using panel OLS regression, in a way similar to that used in other studies (Vithessonthi and Tongurai 2016). These findings confirm that financial development increases the risk-taking of banks by reducing

their capitalization, which is in line with the baseline predictions. This study provides results on the full sample of banks to save space.

5. Conclusion and Policy implications

The purpose of this study was to investigate the effect of financial development on the risk-taking of US commercial banks from 2002 to 2019. Risk-taking is a significant determinant of bank stability, growth, and performance. It was necessary to investigate the impact of financial development on bank risk-taking in the USA. We used the two-step GMM method to test the hypotheses because it enabled control over the problems of autocorrelation, cross-sectional heteroscedasticity, and endogeneity.

We use agency theory, regulatory theory, the competition fragility hypothesis, and the competition stability hypothesis to link financial development to bank risk-taking. Based on these theories, we set three hypotheses to assess the impact of financial development on the risk-taking of large commercial banks in the USA. The results show that financial development increases risk-taking by lowering bank equity ratio. In contrast, the impact of financial development on the risk-weighted assets of commercial banks is negative. The overall sample confirms that financial development has a positive impact on the stability of banks. These findings provide evidence that financial development does not influence the stability of well-capitalized banks. Financial development (SMC) increases the risk of adequately-capitalized banks by lowering the capital ratio and increasing these banks' investment in risk-weighted assets. However, the impact of financial development (DCB) on influencing the risk-taking of adequately-capitalized banks is weak. Financial development increases the risk of under-, significantly under-capitalized, and low-liquidity banks by increasing investment in risk-weighted assets. These results show that the impact of financial development on the risk-taking of banks is higher in pre-crisis than in peri- and post-crisis eras.

Regulators and policymakers should consider trends in financial development along with bank capital for the stability of banks. The heterogeneity of these findings has implications on the improvement of the financial system for policymakers in commercial banking. These results can help regulators to observe commercial banks' regulatory capital ratios by considering the impact of the financial development movement. Finally, our heterogeneous study results have implications for well-, adequately-, under-, significantly under-capitalized, high-, and low-liquidity banks in pre-, peri-, and post-crisis periods.

This study remains limited to the analysis of quantitative information for large commercial banks listed in the FDIC on 31 December 2019. As such, we are still unable to collect data from a more extended period and from smaller commercial banks, investment banks, saving banks, and other financial firms. Future research could be conducted to study the financial development and risk-taking of banking industries by incorporating the mediating/moderating role of different economic variables and regulations to achieve more in-depth insights.

References

1. ABBAS, F., and ALI, S. 2020. Dynamics of bank capital ratios and risk-taking: Evidence from US commercial banks. *Cogent Economics & Finance*, **8**(1), 1838693. https://doi.org/10.1080/23322039.2020.1838693
2. ABBAS, F., ALI, S., and RUBBANIY, G. 2021. Economics of capital adjustment in the US commercial banks: empirical analysis. *Journal of Applied Economics*, **24**(1), 71–90. https://doi.org/10.1080/15140326.2021.1881877
3. ABBAS, F., BATOOL, N., and SULEHRI, F. A. 2020. Investment, financial, trade freedom and risk-taking: Empirical evidence from USA. *Studies of Applied Economics*, **39**(2).
4. ABBAS, F., and MASOOD, O. 2020. How do large commercial banks adjust capital ratios: empirical evidence from the US? *Economic Research-Ekonomska Istraživanja*, **33**(1), 1849–1866. https://doi.org/10.1080/1331677X.2020.1763823
5. ABBAS, F., YOUSAF, I., ALI, S., and WONG, W.-K. 2021. Bank capital buffer and economic growth: New insights from the US banking sector. *Journal of Risk and Financial Management*, **14**(4), 142. http://dx.doi.org/10.3390/jrfm14040142
6. ABDUL HAMID, B., AZMI, W., and ALI, M. 2020. Bank risk and financial development: Evidence from dual banking countries. *Emerging Markets Finance and Trade*, **56**(2), 286–304. https://doi.org/10.1080/1540496X.2019.1669445
7. ARELLANO, M., and BOND, S. 1991. Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The Review of Economic Studies*, **58**(2), 277–297. https://doi.org/10.2307/2297968
8. AYUSO, J., PÉREZ, D., and SAURINA, J. 2004. Are capital buffers pro-cyclical?: Evidence from Spanish panel data. *Journal of Financial Intermediation*, **13**(2), 249–264. https://doi.org/10.1016/S1042-9573(03)00044-5
9. BECK, T. 2008. *Bank competition and financial stability: friends or foes?* Washington, DC: The World Bank.
10. BERNANKE, B., GERTLER, M., and GILCHRIST, S. 1998. The financial accelerator in a quantitative business cycle framework. *NBER Working Paper 6455*.
11. BIKKER, J. A., and METZEMAKERS, P. A. 2005. Bank provisioning behaviour and procyclicality. *Journal of International Financial Markets, Institutions and Money*, **15**(2), 141–157. https://doi.org/10.1016/j.intfin.2004.03.004
12. CLAESSENS, S., KOSE, M. A., and TERRONES, M. E. 2012. How do business and financial cycles interact? *Journal of International Economics*, **87**(1), 178–190. https://doi.org/10.1016/j.jinteco.2011.11.008
13. DEMIRGÜÇ-KUNT, A., and HUIZINGA, H. 2000. Financial structure and bank profitability. P*olicy Research Working Paper, No. WPS2430*. Washington, DC: The World Bank. http://documents.worldbank.org/curated/en/364151468749353823/Financial-structure-and-bank-profitability
14. DING, D., and SICKLES, R. C. 2018. Frontier efficiency, capital structure, and portfolio risk: An empirical analysis of US banks. *BRQ Business Research Quarterly*, **21**(4), 262–277. https://doi.org/10.1016/j.brq.2018.09.002

15. ESPENLAUB, S., KHURSHED, A., and SITTHIPONGPANICH, T. 2012. Bank connections, corporate investment and crisis. *Journal of Banking & Finance*, **36**(5), 1336–1353. https://doi.org/10.1016/j.jbankfin.2011.11.024
16. FOOS, D., NORDEN, L., and WEBER, M. 2010. Loan growth and riskiness of banks. *Journal of Banking & Finance*, **34**(12), 2929–2940. http://dx.doi.org/10.1016/j.jbankfin.2010.06.007
17. GIMET, C., and LAGOARDE-SEGOT, T. 2012. Financial sector development and access to finance. Does size say it all? *Emerging Markets Review*, **13**(3), 316–337. https://doi.org/10.1016/j.ememar.2011.11.002
18. GUISO, L., SAPIENZA, P., and ZINGALES, L. 2004. Does local financial development matter? *The Quarterly Journal of Economics*, **119**(3), 929–969.
19. HUSSAIN, F., and KUMAR CHAKRABORTY, D. 2012. Causality between financial development and economic growth: Evidence from an Indian State. *Romanian Economic Journal*, **15**(45).
20. JACQUES, K., and NIGRO, P. 1997. Risk-based capital, portfolio risk, and bank capital: A simultaneous equations approach. *Journal of Economics and business*, **49**(6), 533–547.
21. JIANG, L., LEVINE, R., and LIN, C. 2017. Does competition affect bank risk? *NBER Working Paper No. 23080*. https://doi.org/10.3386/w23080
22. JOKIPII, T., and MILNE, A. 2008. The cyclical behaviour of European bank capital buffers. *Journal of Banking & Finance*, **32**(8), 1440–1451.
23. JOKIPII, T., and MILNE, A. 2011. Bank capital buffer and risk adjustment decisions. *Journal of Financial Stability*, **7**(3), 165–178.
24. KING, R. G., and PLOSSER, C. I. 1982. The behavior of money, credit, and prices in a real business cycle. *NBER Working Paper No. 0853*. https://doi.org/10.3386/w0853
25. LAW, S. H., TAN, H. B., and AZMAN-SAINI, W. 2015. Globalisation, institutional reforms and financial development in East Asian economies. *The World Economy*, **38**(2), 379–398. https://doi.org/10.1111/twec.12168
26. LEVINE, R., and ZERVOS, S. 1998. Stock markets, banks, and economic growth. *American Economic Review*, **88**(3), 537–558.
27. LINDQUIST, K.-G. 2004. Banks' buffer capital: How important is risk. *Journal of International Money and Finance*, **23**(3), 493–513. https://doi.org/10.1016/j.jimonfin.2004.01.006
28. MARCUS, A. J. 1984. Deregulation and bank financial policy. *Journal of Banking & Finance*, **8**(4), 557–565. https://doi.org/10.1016/S0378-4266(84)80046-1
29. MERTON, R. C. 1995. A functional perspective of financial intermediation. *Financial Management*, **24**(2), 23–41.
30. NDIKUMANA, L. 2005. Financial development, financial structure, and domestic investment: International evidence. *Journal of International Money and Finance*, **24**(4), 651–673. https://doi.org/10.1016/j.jimonfin.2005.03.006
31. PESARAN, M. H., SCHUERMANN, T., TREUTLER, B.-J., and WEINER, S. M. 2006. Macroeconomic dynamics and credit risk: a global perspective. *Jour-*

nal of Money, Credit and Banking, **38**(5), 1211–1261. http://dx.doi.org/10.1353/mcb.2006.0074
32. ROODMAN, D. 2009. A note on the theme of too many instruments. *Oxford Bulletin of Economics and Statistics*, **71**(1), 135–158. https://doi.org/10.1111/j.1468-0084.2008.00542.x
33. SHAHBAZ, M., BHATTACHARYA, M., and MAHALIK, M. K. 2018. Financial development, industrialization, the role of institutions and government: a comparative analysis between India and China. *Applied Economics*, **50**(17), 1952–1977. https://doi.org/10.1080/00036846.2017.1383595
34. SHRIEVES, R. E., and DAHL, D. 1992. The relationship between risk and capital in commercial banks. *Journal of Banking & Finance*, **16**(2), 439–457. https://doi.org/10.1016/0378-4266(92)90024-T
35. STOLZ, S., and WEDOW, M. 2011. Banks' regulatory capital buffer and the business cycle: Evidence for Germany. *Journal of Financial Stability*, **7**(2), 98–110. https://doi.org/10.1016/j.jfs.2009.09.001
36. TONGURAI, J., and VITHESSONTHI, C. 2020. Bank regulations, bank competition and bank risk-taking: Evidence from Japan. *Journal of Multinational Financial Management*, **56**, 100638. https://doi.org/10.1016/j.mulfin.2020.100638
37. TRAN, S. H., and NGUYEN, L. T. 2020. Financial development, business cycle and bank risk in Southeast Asian countries. *The Journal of Asian Finance, Economics, and Business*, **7**(3), 127–135. http://dx.doi.org/10.13106/jafeb.2020.vol7.no3.127
38. VITHESSONTHI, C. 2014a. The effect of financial market development on bank risk: evidence from Southeast Asian countries. *International Review of Financial Analysis*, **35**, 249–260. https://doi.org/10.1016/j.irfa.2014.10.005
39. VITHESSONTHI, C. 2014b. Financial markets development and bank risk: Experience from Thailand during 1990–2012. *Journal of Multinational Financial Management*, **27**, 67–88. https://doi.org/10.1016/j.mulfin.2014.05.003
40. VITHESSONTHI, C., and TONGURAI, J. 2016. Financial markets development, business cycles, and bank risk in South America. *Research in International Business and Finance*, **36**, 472–484. https://doi.org/10.1016/j.ribaf.2015.10.012
41. WILLIAMS, J., and NGUYEN, N. 2005. Financial liberalisation, crisis, and restructuring: A comparative study of bank performance and bank governance in South East Asia. *Journal of Banking & Finance*, **29**(8–9), 2119–2154. https://doi.org/10.1016/j.jbankfin.2005.03.011
42. WINDMEIJER, F. 2005. A finite sample correction for the variance of linear efficient two-step GMM estimators. *Journal of Econometrics*, **126**(1), 25–51. https://doi.org/10.1016/j.jeconom.2004.02.005
43. YAGLI, I. 2020. Bank competition, concentration and credit risk. *Intellectual Economics*, **14**(2), 17–35. https://doi.org/10.13165/IE-20-14-2-02

Appendix 1

Panel OLS Prediction Framework: The Effect of Financial Development on Bank Risk-taking

In line with the research of Vithessonthi and Tongurai (2016), this study uses panel OLS to consider the effect of financial market development on the risk-taking of large commercial banks. To keep in mind the criteria of the OLS panel hypotheses, this analysis considers cross-section fixed-effects (bank dummies) to handle possible unobserved time-invariant bank effects, time-fixed effects (year dummies) to handle possible unobserved time-variant effects, or both. (Vithessonthi and Tongurai 2016). To control the potential problem of endogeneity, we take the one-period lagging value for explanatory variables that is appropriate to address the reverse-causality issue, as argued for by Vithessonthi and Tongurai (2016). This study estimates the following baseline regression for results:

$$BR_{i,t} = \alpha + \beta_1 FMD_{i,t-1} + \delta CV_{i,t-1} + \eta_i + \nu_t + \varepsilon_{i,t} \quad (1)$$

Where represents a dependent proxy for bank risk-taking (bank capitalization, RWATA, and Z-score index) concerning the time and cross-section. refers to the independent proxies for financial market development (domestic credit provided by banks to the private sector to GDP ratio, stock market capitalization to GDP ratio, and banking industry assets to GDP ratio), time, and cross-sections. Shows the list of control variables that include liquidity, profitability, loan growth, deposits ratio, bank size, trade openness, real gross domestic product, and inflation rate. The symbol represents bank-fixed effects; period-fixed effects, and the zero-mean disturbance term. The problem of heteroscedasticity and autocorrelation is clustered at the cross-section level for consistent standard errors. We apply this model both overall and for well-, adequately-, under-, significantly under-capitalized, high-, and low-liquidity large commercial banks separately.

Base model results for the full sample using the Panel OLS method.

Table 10. *The robustness of the results of the impact of financial development on bank risk-taking for the full sample of banks*

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Capital ratio	RWA	Z-Score	Capital ratio	RWA	Z-Score
Lagged risk-taking	0.880***	0.881***	0.991***	0.880***	0.887***	0.991***
	(0.004)	(0.004)	(0.001)	(0.004)	(0.004)	(0.001)
SMC_{t-1}	−0.049***	−0.824***	0.141***			
	(0.012)	(0.061)	(0.040)			
DCB_{t-1}				−0.001	−0.221***	0.032***
				(0.003)	(0.016)	(0.011)
$Liquidity_{t-1}$	0.005*	0.094***	0.016*	0.006**	0.053***	0.015*
	(0.003)	(0.014)	(0.009)	(0.003)	(0.014)	(0.009)

	(1)	(2)	(3)	(4)	(5)	(6)
Profitability $_{t-1}$	0.013	0.123*	−0.469***	0.007	0.180***	−0.490***
	(0.013)	(0.067)	(0.045)	(0.013)	(0.066)	(0.045)
Loan ratio $_{t-1}$	−0.001***	0.039***	−0.003**	−0.001***	0.042***	−0.003**
	(0.000)	(0.003)	(0.002)	(0.000)	(0.003)	(0.002)
Deposit ratio $_{t-1}$	−0.000	−0.001	0.000	−0.000	−0.001	0.000
	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Bank size $_{t-1}$	0.001***	0.002***	0.002***	0.001***	0.001***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Business trend $_{t-1}$	0.004	0.370***	0.028	−0.011	0.301***	−0.060**
	(0.007)	(0.034)	(0.023)	(0.007)	(0.038)	(0.025)
Trade openness $_{t-1}$	0.000	0.000***	−0.000***	0.000	0.000***	−0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Inflation rate $_{t-1}$	−0.000**	−0.002***	−0.001***	−0.000**	0.009***	−0.000
	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)
Constant	0.008***	−0.042***	0.015***	0.005**	0.123***	0.020***
	(0.001)	(0.007)	(0.005)	(0.002)	(0.010)	(0.006)
Observations	16,065	16,065	16,065	16,065	16,065	16,065
Number of id	945	945	945	945	945	945
R-square	0.55	0.59	0.56	0.55	0.59	0.56

Robust standard errors are reported in parenthesis (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$)