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Article

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FINANCIAL ECONOMICS | RESEARCH ARTICLE

Commercial bank capital and risk in India: Does financial crisis matter?

Seba Mohanty^{1*} and Jitendra Mahakud¹

Abstract: This study investigates the relationship between bank capital and risk in the Indian banking sector. The sample consists of 68 commercial banks including public-sector banks, private-sector banks and foreign banks. We employ panel granger causality test to find out the relationship between risk and capital. The result signifies that there is a unidirectional causality, i.e. risk is causing capital for all the three types of commercial banks. Furthermore, we examine the impact of risk on capital with some bank-specific variables and regulatory pressure as control variables using generalised method of moments (GMM) technique. The results reveal that bank risk, bank-specific variables and regulatory pressure are significantly affect the bank capital, and the results vary across the ownership of the banks. Finally, we examine the impact of risk on bank capital between with and without financial crisis period. We find that risk is positively affecting the bank capital ratio under both periods in the case of public-sector banks, but the rate of change is more on with financial crisis period than without crisis period. The impact of risk on bank capital has been highest for the private-sector banks.

Subjects: Economics; Finance; Banking; Business, Management and Accounting

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PUBLIC INTEREST STATEMENT

In recent years, so many banking crises happened all over the world, which could be due to the imbalance in the capital and risk levels of the banks. Though Basel Committee set a minimum capital ratio for all over the world, still banks are facing the problem of instability due to the increase in risk. Therefore, this study finds the relationship between bank capital and risk in an emerging country. The results show the unidirectional causality between risk and capital, i.e. risk is causing capital. This study has the implications for the bankers to devise certain mechanism to reduce the bank risk, which help them to keep certain level of bank capital to minimize the probability of instability and also increase the profitability.

Keywords: bank capital; risk; panel granger causality; generalized method of moments; financial crisis

JEL Classification: G21; G28

1. Introduction

Over the years, the regulators and policy makers focus on the maintenance of the particular level of bank capital ratio to minimize the solvency and liquidation risk of the commercial banks. According to the Basel Committee on Banking and Supervision (1988), banks should maintain 8% risk-weighted capital adequacy ratio (CAR). Although Basel Committee imposes a single capital ratio for different countries, the minimum requirements of bank capital have been varied across the countries due to the changes in asset portfolio of the banks. Therefore, the debate on the maintenance of a particular risk-based capital ratio defined for commercial banks across the countries is still unsettled. Some banks may alter capital directly (i.e. by raising new capital), while others may adjust the risk-weighted assets which may depend on the characteristics and financial condition of the banks (Alfon, Argimon, & Bascunana-Ambros, 2004; Wong, Ho, & Autio, 2005) as well as the state of the economy (Ayuso, Perez, & Saurina, 2004; Jokipii & Milne, 2008; Lindquist, 2004; Stolz & Wedow, 2005).

Academic research on the relationship between bank capital and risk finds that capital and risk decisions are made simultaneously and are interrelated. One strand of literature assumes a positive association between risk and capital. Rime (2001) argues that increase in risk leads the banks to increase the capital to avoid the regulatory cost. Banks may increase the capital levels by increasing the asset risk exposure which is supported by bank owners' and managers' private incentives (Shrieves & Dahl, 1992). Other strand of the literature (Aggarwal & Jacques, 1998; Das & Ghosh, 2004) argues that there is a negative relationship between changes in risk and changes in capital, because banks increase their capital ratio by reducing the portfolio risk generally in the case of undercapitalised and adequately capitalised banks. These conflicting evidences on the relationship between risk and capital motivate us to revisit this issue in the context of the Indian commercial banks.

Indian banking system is characterized by a large number of banks with mixed ownership and branch banking system. State owned banks play a major role for the growth of the banking sector in India. In addition, when we compared to other developed countries and developing countries, deposit insurance plays an important role for depositors' safety while it is lagging behind in the case of India. Therefore, it is very much difficult for the banks to avoid the risk and therefore regulators are very strict towards the capital ratio of commercial banks for maintaining a stable banking system. In the wake of liberalisation of the Indian economy, the Narsimham committee adopted the Basel committee recommendation of maintaining 8% CAR and Reserve Bank of India (RBI) has also accepted and implemented the same with effective from 30 April 1995. However, RBI has raised the minimum regulatory capital adequacy requirement to 9% in the midterm review of Monetary and Credit policy in October 1998 and the banks are advised to attain this level by 31 March 2009. Similarly, at the same time due to the liberalisation of the Indian economy many private and foreign banks started their operation in India. The performance of banking sector was good up to the global financial crisis and the capital base was strong, but it has been observed that commercial banks are experiencing pressure on their margin requirements in the years 2011 and 2012. The CAR has declined marginally, non-performing assets (NPA) have increased and asset quality has declined (Shukla, 2014). In this regard, the trends in average rate of CAR of commercial banks in India have been changing across the period and the types of banks.

The available studies on bank capital in the context of Indian commercial banks have largely focussed on determinants of capital and risk and mostly carried out for public-sector banks only (Das & Ghosh, 2004; Ghosh, Nachene, Narain, & Sahoo, 2003; Hussain & Hassan, 2005). The lack of research on bank capital and risk relationship in the context of all type of commercial banks

operating in India put forth many pertinent unanswered research questions. The major questions are as follows: (i) Are risk and bank capital determined simultaneously? (ii) Whether there has been a bi-directional or unidirectional relationship between risk and capital? (iii) Does the relationship between risk and capital vary across the type of banks? (iv) What are the other possible determinants of bank capital ratios? (v) What is the impact of financial crisis on bank capital ratio? In this paper, we attempt to examine such questions in the context of three types of commercial banks such as public, private and foreign banks operating in India.

In the global context, empirical studies on the relationship between bank capital and risk have largely used the simultaneous equation models with the pre-assumption that there has been a bi-directional causality between these two variables. Relaxing of this assumption, this study first tries to test the direction of the causality between risk and capital by using a panel granger causality test and further the generalised method of moment (GMM) approach has been used to examine the impact of one on the other. We have used both capital to asset ratio and capital to risk-weighted asset ratio as the proxies for bank capital ratio. Similarly, we use three different proxies such as non performing loans to total loans ratio, loan loss provisions (LLR) to total loans ratio and Hannan and Hanweck (1988) risk index to measure bank risk. However, due to the unavailability of the data, the Hannan and Hanweck (1988) risk index could not be used for the foreign banks. Furthermore, our study includes some control variables such as bank size, net interest margin (NIM), loan to asset ratio (LAR), bank liquidity (BL) and regulation to examine the impact of bank-specific and regulatory pressure (RP) on capital ratios. Our panel granger causality test result shows a unidirectional causality between risk and capital for all type of banks in India, that risk is causing capital. In addition to the risk, we also find that some bank-specific factors and RP play the important role in determining the capital ratio of commercial banks in the case of India and the results are varying across the ownership of the banks.

This paper is organised as follows. Section 2 presents the review of literature. Section 3 highlights the variables and data. Section 4 specifies the model and methodology. The empirical results are discussed in Section 5. The robustness of the results is checked in Section 6. Finally, Section 8 concludes the paper.

2. Literature review

An extant body of literature provides several compelling arguments towards both the positive and negative relationship between bank capital and risk. Using the simultaneous equation model Rime (2001) finds that change in capital significantly explained by changes in risk levels for the 149 Swiss banks over a period of 1985 to 1989. This study also suggests that RP induces banks to increase their capital but it does not affect the level of risk. Jacques and Nigro (1997) analyse the relation between bank capital, portfolio risk and the risk-based standards, and suggest that there is a negative relationship between portfolio risk and capital and the risk-based capital standard plays an important role for increase in capital and decrease in portfolio risk of banks. Ahmad, Ariff, Skully, and Michael (2008) support the view of Rime (2001) and suggest that there is a strong positive link between regulatory capital and bank risk for Malaysian banks during the period 1997–98 to 2007–2008. Shrieves and Dahl (1992) empirically investigate the relationship between changes in capital and changes in risk by using nearly 1800 FDIC-insured independent and holding company affiliated commercial banks. The results supports that there is a positive association between changes in risk and capital and the capital base of the bank changes in accordance with the risk level. Considering the German banks during the period 1992 to 2001, Kleff and Weber (2008) find a significant positive relationship between the target capital ratios and changes in risk levels for moderately capitalised banks. In the case of less-capitalised banks this study finds a smaller or even a negative relationship between changes in portfolio risk and changes in the capital ratio, indicating that such banks try to increase capital levels either by raising capital or by reducing risk. In the case of highly capitalised banks this study finds no significant impact of changes in portfolio risk on changes in capital ratios. Aggarwal&Jacques(1998) finds a significant negative relationship between changes in capital ratio and changes in risk levels for 2552 Federal

Deposit Insurance Corporation-insured commercial banks with assets of \$100 during 1990 to 1993. Available empirical studies on Indian commercial banks have largely focussed on the determination of bank capital. Nachane, Narain, Ghosh, and Sahoo (2000) find that bank size, net income to total asset is the major determinants of bank capital for the public-sector banks during 1997–1999. This study also concludes that changes in capital and changes in risk are negatively related and this result is supported by Hussain and Hassan (2005). Furthermore, the studies finds that RP and bank management decision also play a dominant role in determining the capital ratio for Indian Public Sector Banks (Ghosh et al., 2003; Das & Ghosh, 2004).

While reviewing the empirical literature on the relationship between bank capital and risk we observe that the results are conflicting and vary across the time, countries, and the type of banks. Mostly all these studies are based on the assumption that there has been a simultaneous relationship between changes in capital and changes in risk. Considering the studies on Indian commercial banks, we find that there has been a single study carried out by Das and Ghosh (2004) which has focussed on the relationship between risk and capital. But this study has also certain limitations: (i) it considers only the public-sector banks and (ii) the methodology adopted in this study is same as Rime (2001), which assumes that there is a simultaneous relationship between risk and capital and the determinants of capital and risk are same. The present study tries to overcome these limitations, first this study considers all the three types of commercial banks such as public-sector, private-sector and foreign banks operating in India. Second, this present paper uses different methods such as panel granger causality and GMM which do not follow the same assumption taken by the previous studies. Third, unlike other studies this study has used three measures of risk such as NPA, LLR and Z-risk index (ZRISK).

3. Variables and data

3.1 Variables

3.1.1. Capital ratio

Following Shrieves and Dahl (1992), Jacques and Nigro (1997), Aggarwal & Jacques (1998), Ediz, Michael, and Perraudin (1998), Das and Ghosh (2004) and Ahmad et al. (2008), we use two measures of capital ratio (i) total capital to total assets ratio (CR) and (ii) total capital to total risk-weighted assets ratio (CAR). The capital includes both tier-I (core capital) and tier-II (subordinated capital) capital and risk-weighted asset is measured according to the weight given to each type of asset according to the risk profile of the asset portfolio.

3.1.2. Risk

Three different proxies, such as NPA, LLR and ZRISK index (Ahmad et al., 2008), have been used to measure the risk.

3.1.2.1. *NPA.* NPA shows the quality of the loan portfolio and it generally is accepted as a measure of credit and default risk. Due to increase in NPA, the overall profitability of the bank declines and at the same time risk increases. An increase in risk reduces the capital ratios. Therefore, we expect a negative relationship between the capital ratio and non-performing loans. NPA is calculated as a percentage of non-performing loans to total loans.

3.1.2.2. *LLR.* Loan loss reserve is defined as a valuation reserve against a bank's total loans on the balance sheet, representing the amount thought to be adequate to cover estimated losses in the loan portfolio. This indicates the financial health of the banks. A negative impact of LLR in capital could mean that banks in financial distress have more difficulties in increasing their capital ratio. In contrast, a positive effect could signal that banks voluntarily increase their capital to a greater extent in order to overcome their bad financial situation. LLR is calculated as a percentage of LLR to total loans.

3.1.2.3. **ZRISK.** The ZRISK represents the Hannan and Hanweck's (1988) accounting model of bank risk index. Thus, it can be calculated as follows:

$$\text{ZRISK}_{i,t} = [\text{ROA}_{i,t} + \text{EQTA}_{i,t}] / S_{\text{ROA}}$$

where the ROA is return on average assets, EQTA refers to the equity capital-to-asset ratio and S_{ROA} is the standard deviation of ROA. Return on average asset is equal to net income divided by average total assets. We compute the S_{ROA} for each bank over the observed time period and we get the value of ZRISK based on a time series approach over 18 years. As the ROA provides an overview of the bank's performance, its standard deviation describes the volatility of bank earnings. The equity capital-to-total assets ratio, on the other hand, shows the amount of equity capital available to absorb unexpected losses. Thus, the index incorporates three standard elements of bank risk and measures how much the earnings can decline until the bank has a negative book value and so becomes insolvent. A low ZRISK implies a riskier bank whereas a higher ZRISK implies a safer bank. While a positive sign on NPL variable signifies a positive, a negative ZRISK variable indicates a positive relationship between capital and risk.

3.1.3. Control variables

Although the variables of interest in this paper are NPA, LLR and ZRISK, following the existing literature (Gropp & Heider, 2007; Shrieves & Dahl, 1992), we have included certain bank-specific variables like bank size NIM (Ahmad et al., 2008), BL (Ahmad et al., 2008; Yu, 2000), LAR (Buyuksalvarci & Abdioglu, 2011; Mpuga, 2002), and RP (Rime, 2001; Shrieves & Dahl, 1992) to find the impact of risk on capital and capital on risk. The measurement of variable is as follows: bank size (SZ) is measured as a log of total asset. NIM is calculated as the ratio of net interest income to total earning assets. BL is measured in terms of liquid asset to total deposit ratio. LAR is calculated as the ratio of total loans to total assets. RP is measured through a dummy variable. It takes the value 1 if the bank capital is at least equal to the regulatory minimum and zero otherwise. Following the regulatory norm of India the variable is unity for banks with capital ratio less than 9% and zero otherwise.

3.2 Data

This study considers balanced panel data of three types of commercial banks such as public-sector banks, private-sector banks and foreign banks operating in India. Our study fails to cover the cooperative banks, due to unavailability of required data. The period of study is chosen considering the banking sector reforms in India during the post liberalization period. Although, with the recommendation of Narasimham Committee Report in 1992, the banking sector reforms in India started since 1991–1992, the target period for the implementation of the Basle-I norms with regard to the maintenance of minimum CAR of 8% was given up to 1997–98 by RBI. Furthermore, the RBI has changed the minimum regulatory CAR requirement to 9% in the year 1996–97. It has been continued up to 2013–2014. After the implementation of Basle-III, the CAR has been kept at 9% but in addition to that another 2.5% capital conservation buffer has been made mandatory. Keeping all these points in the mind, the period of study for this analysis has been chosen from March 1997 to March 2014. A total sample of 68 banks has been chosen as the relevant data for those banks are available continuously during the study period. Out of the total 68 banks, the 26 banks are public-sector banks, 18 banks are private-sector banks and remaining 24 banks are foreign banks operating in India. The data has been collected from the various publications of RBI, Prowess data base maintained by Centre for Monitoring Indian Economy (CMIE), CIEC data base, a product of the Euro Money Institutional Investor Company and India stat data base, respectively.

Table 1 shows the yearly average CAR of the commercial banks classified on the basis of ownership, asset size, profitability and NPA. According to the ownership we consider three types of commercial banks such as public-sector, private-sector and foreign banks. We observe that the average CAR of the public-sector banks has been lowest followed by private and foreign banks. One

Table 1. Bank capital ratio across the banks classified on the basis of size, profitability, non-performing asset and ownership during the period 1996–97 to 2013–14

Year	Ownership			Size		
	Public-sector banks	Private-sector banks	Foreign banks	Large-size banks	Medium-size banks	Small-size banks
1997	9.43	12.02	41.00	9.06	10.39	45.36
1998	10.85	12.18	41.67	10.76	11.56	44.92
1999	10.64	12.22	47.48	10.52	11.41	51.45
2000	10.85	12.20	31.81	10.62	11.85	34.00
2001	10.85	11.59	33.24	10.70	11.49	35.37
2002	11.25	12.14	41.00	11.25	12.05	43.60
2003	12.17	12.16	35.27	12.43	12.29	36.97
2004	13.00	13.77	38.12	13.09	13.01	40.92
2005	12.73	12.58	40.10	12.45	13.66	41.78
2006	12.23	12.28	45.95	12.21	12.66	48.63
2007	12.26	12.30	42.63	12.16	12.54	45.25
2008	13.20	13.47	39.49	12.90	14.40	41.17
2009	13.22	14.44	49.90	13.59	14.26	52.77
2010	13.26	15.32	51.69	14.30	14.90	54.07
2011	13.37	14.61	52.22	14.14	14.41	54.88
2012	12.98	14.25	52.97	13.66	14.11	55.76
2013	12.15	14.38	48.32	13.20	14.43	49.95
2014	11.12	14.45	43.83	12.17	14.27	45.15
Year	Profitability			Non-performing assets (NPA)		
	High-profit banks	Medium-profit banks	Low-profit banks	High-NPA banks	Medium-NPA banks	Low-NPA banks
1997	21.58	10.89	31.76	11.39	14.15	39.02
1998	37.85	11.24	16.95	12.94	18.33	35.58
1999	30.95	11.2	30.29	14.82	13.53	44.75
2000	31.89	11.86	11.78	15.38	17.31	23.33
2001	28.29	12.33	16.12	16.44	16.55	24.09
2002	29.41	14.47	22.09	27.89	11.56	26.72
2003	29.19	14.82	16.81	24.20	12.43	24.52
2004	26.98	19.92	19.20	22.45	15.86	28.17
2005	26.87	18.48	21.69	20.50	16.68	30.22
2006	34.97	15.79	21.59	17.24	16.21	39.68
2007	38.96	16.33	13.27	14.29	15.53	39.89
2008	38.73	15.60	12.96	16.49	13.60	38.30
2009	25.49	18.19	36.22	15.68	13.50	51.39
2010	24.24	17.13	41.35	17.46	14.31	51.38
2011	28.26	39.85	13.52	18.62	14.28	50.33
2012	32.28	14.68	35.69	19.43	15.00	48.81
2013	26.84	17.24	32.77	18.97	14.86	43.48
2014	23.11	16.79	31.07	14.53	15.24	41.67

Note: Author's own calculation

of the plausible reasons could be that in times of uncertain market condition government may extent financial assistance to the public-sector banks, but it may not be the case for private and foreign banks. Therefore, private and foreign banks keep more CAR than public-sector banks. In addition to the ownership, we also divide all the banks into different categories according to the size of the banks, profitability of the banks and NPA of the banks. We measure the size in terms of total asset of the banks. Similarly, profitability is measured by return on assets and NPA is measured as total NPA to total advances.

We have divided the banks into three groups by using the tercile approach i.e. first tercile (large-size banks, high-profit banks, and high-NPA banks), second tercile (medium-size, medium-profit banks, and medium-NPA banks) and third tercile (small-size banks, low-profit banks and low-NPA banks). The figures presented in the table reveal that the average CAR of the large banks has been the minimum in comparison with medium-size and small-size banks. This finding is consistent with the too big to fail hypothesis that the probability of failure of large banks is lesser than the smaller banks because large banks can diversify their asset portfolio in a better way to enhance their profit than the smaller banks and profit is a important factor to raise capital. The analysis indicates that banks having more profit keep more capital ratios than medium- and low-profit banks. This is due to the fact that high-profit generating banks can easily raise their equity capital from their retained earnings than other type of banks. The CAR of the banks having high NPA is lesser in comparison with the banks with less NPA. It could be because of the fact that in the case of Indian commercial banks the rate of increase in NPA is more for public-sector banks than private and foreign banks and public-sector banks have lesser CAR ratio due to the more government support and probability of failure of these banks are less.

Within the specific groups we find that the CAR of public-sector banks and private-sector banks are almost follow a similar pattern over the 18 years. But there is a remarkable change of CAR in the year 2008 to 2009 in the case of foreign banks. It could be because of market conditions of other countries after the financial crisis 2007. Similarly the pattern of CAR across the different size of the banks is almost same in all years in the case of public and foreign banks, but there has been an increasing trend in CAR in the case of medium-size banks. All the groups categorized on the basis of profitability are following almost the same pattern across the years. The NPA level across the banks is also varying across the banks classified on the basis of NPA. It is observed that for the banks having high NPA, in 2002 there is a 11% increase in CAR after that it follows a reducing pattern. The CAR of banks with medium-NPA level is consistent across the years. In the case of banks having lowest NPA there is a remarkable change in CAR in the year 2009. This could be because of the impact of financial crisis on foreign banks.

We present the summary of statistics of all the variables in the beginning step and the results are represented in Table 2. It reveals that the average CAR is the highest for foreign banks followed by private and public-sector banks. It indicates that foreign banks are more concerned about their capital ratio than the other banks in India. In the case of capital ratios also, it is highest for foreign banks followed by public and private banks. The mean value of NPA is almost same for all banks and quite high for public-sector banks, which indicates that risk is high in the case of public-sector banks than private and foreign banks. Similarly in the case of LLR the mean value is slight high for foreign banks and quite similar for all other banks which shows that foreign banks are more cautious for risk than the other banks. The mean value of ZRISK for public-sector banks is 2.54% and for private-sector banks it is quite high, i.e. 4.84, which indicates that private banks are safer than public-sector banks. ZRISK could not be measured in the case of foreign banks due to unavailability of data. There is not much difference in the case of size for all types of banks.. The mean value of NIM is high for foreign banks and almost same for public and private-sector banks. It implies that foreign banks are more efficient to protect against liquidation. Similarly, the mean value of LAR is almost similar for all banks and is slightly high for foreign banks. The descriptive statistics indicates that BL is highly volatile irrespective of all the banks, which support the notion that the demand for currency by the public has been changing frequently.

Table 2. Summary statistics

Variables	Public-sector banks		Private-sector banks		Foreign banks	
	Mean	SD	Mean	SD	Mean	SD
CR	1.44	2.45	0.82	1.23	18.50	11.87
CAR	11.36	3.72	12.33	4.65	40.94	19.66
NPA	3.75	0.79	2.97	3.23	3.56	8.15
LLR	1.26	1.01	1.13	0.96	1.85	6.05
ZRISK	2.54	1.65	4.84	5.56	-	-
SZ	13.21	1.15	11.59	1.50	9.52	2.22
NIM	2.95	19.13	3.00	1.09	13.65	61.04
LAR	51.42	11.01	50.98	13.21	36.17	6.05
BL	14.97	15.04	32.11	6.22	86.66	5.21

Note: Authors own calculation. CAR, capital adequacy ratio; ZRISK, bank risk index; NPA, non-performing asset; SZ, log of total asset; NIM, net interest margin; LAR, loan-to-asset ratio; BL, bank liquidity.

Table 3. Pair wise t-statistics for selected variables by bank groups: public-sector banks, private-sector banks and foreign banks

Variables	Public versus Private Sector Banks	Private versus Foreign Banks	Public versus Foreign Banks
CR	6.27***	5.64***	12.32**
CAR	-4.74***	-22.52***	-21.80***
NPA	2.28*	-3.81**	-2.37*
LLR	7.61**	1.82	4.59**
SZ	42.24***	24.86***	77.24***
NIM	-0.40	-19.06***	-19.00***
LAR	0.69	7.92***	6.87***
BL	2.51*	-1.25	-2.39*

Note: ***, ** and* show the 1%, 5%, and 10% level of significance, respectively.

We show the pair wise t-statistics for the selected variables for public-sector, private-sector and foreign banks. The results presented in Table 3 infer that there is a significant difference between the variables in the case of each type of banks. For this reason, we have considered the three types of banks separately for our analysis.

The correlation matrix of all the independent variables for the whole sample presented in Table 4 reveals that the correlation among the independent variables are reasonably low and insignificant in most of the cases, which rule out the problem of multicollinearity.

4. Model specifications and methodology

4.1 Models specifications

First Panel Granger causality test has been carried out to examine the direction of relationship between capital ratio and risk. Before estimating the panel granger causality, panel unit root tests by Levin, Lin, and Chu (2002) and Im, Pesaran, and Shin (2003) have been undertaken to test the stationarity of the data. Furthermore, the GMM approach has been used to examine the impact of one on the other with the other control variables.

The general form of panel Granger causality framework can be written as follows:

Table 4. Correlation matrix of all the independent variables for all types of banks

Public-sector banks								
Variables	NPA	LLR	ZRISK	SZ	NIM	LAR	BL	RP
NPA	1							
LLR	0.02	1						
ZRISK	0.24*	0.13**	1					
SZ	-0.49*	0.23*	-0.25*	1				
NIM	0.24*	0.31**	-0.12**	-0.30*	1			
LAR	-0.39*	0.26*	0.16*	0.17	-0.43*	1		
BL	-0.06	0.17*	0.46*	-0.28*	-0.27*	-0.14*	1	
RP	0.49*	0.06	0.31	-0.18*	-0.07**	-0.26*	-0.04	1
Private-sector banks								
Variables	NPA	LLR	ZRISK	SZ	NIM	LAR	BL	RP
NPA	1							
LLR	0.00	1						
ZRISK	-0.14	0.02*	1					
SZ	-0.45*	0.16**	0.07**	1				
NIM	-0.09***	0.03*	0.39*	-0.15*	1			
LAR	-0.20*	0.24*	0.18	0.48*	-0.01	1		
BL	0.02	0.17**	0.21*	-0.19*	-0.02	-0.08	1	
RP	0.30*	0.31	-0.29*	-0.14**	-0.00	-0.04	-0.07	1
Foreign banks								
Variables	NPA	LLR	SZ	NIM	LAR	BL	RP	
NPA	1							
LLR	0.004*	1						
SZ	-0.24*	0.15**	1					
NIM	0.02	0.19*	-0.12	1				
LAR	-0.04	0.00	0.27*	-0.08	1		-0.09**	
BL	0.03	0.23**	-0.18*	0.05*		1		
RP	0.003	0.007*	0.02*	-0.02	0.05	-0.02	1	

Note: *, ** and*** show the 1%, 5% and 10% level of significance, respectively.

$$CAP_{i,t} = \alpha_0 + \sum_{j=1}^p \alpha_{1j} CAP_{i,t-j} + \sum_{j=1}^p \alpha_{2j} RISK_{i,t-j} + \varepsilon_{i,t} \tag{1}$$

$$RISK_{i,t} = \beta_0 + \sum_{j=1}^p \beta_{1j} RISK_{i,t-j} + \sum_{j=1}^p \beta_{2j} CAP_{i,t-j} + \phi_{i,t} \tag{2}$$

where t is the time period and i is the cross-sectional dimension. $\Delta CAP_{i,t}$ is the capital of bank i at time period t . Here we are considering both the CAR and the capital ratio of banks; $RISK_{i,t}$ is the risk of bank i at time t . Three risk proxies such as NPA, LLR and ZRISK index is used here. $i = 1, \dots, N$ cross-section units and $t = 1, \dots, T$ time periods. α_0 and β_0 are the intercepts; α_1 and α_2 , β_1 and β_2 are the coefficients, $j = 1, \dots, p$ lags; $\varepsilon_{i,t}$, $\phi_{i,t}$ are the error terms (including not only the disturbance term, but also the individual cross-unit specific effects).

The following models are specified to examine the impact of risk on capital and vice versa:

$$\Delta CAP_{it} = \alpha_0 \Delta CAP_{i,t-1} + \alpha_1 \Delta RISK_{i,t} + \alpha_2 X'_{i,t} + \mu_{it} \tag{3}$$

$$\Delta RISK_{it} = \beta_0 \Delta RISK_{i,t-1} + \beta_1 \Delta CAP_{i,t} + \beta_2 X'_{i,t} + \delta_{it} \tag{4}$$

where t is the time period and i is the cross-sectional dimension. $\Delta CAP_{i,t}$ is the change capital ratio of bank i at time period t ; $\Delta RISK_{i,t}$ is the change in risk of bank i at time period t ; $X'_{i,t}$ is the other control variables which affect both capital and risk, α_0, β_0 , are the intercepts; α_1, β_1 and α_2, β_2 are the coefficients $\mu_{i,t}$, and $\delta_{i,t}$ are the error terms.

5. Methodology

Dumitrescu and Hurlin's (2012) panel causality test has been used to test the causal relationship between bank risk and capital. This test allows all coefficients are different across cross-section. After examining the direction of causality between bank capital and the risk we have used the GMM technique developed by Arellano and Bond (1991) to analyse the impact of one variable on the other with the presence of other control variables. Here we considered the changes in bank capital and changes in risk and other control variables are in the normal form. Consistency of the GMM estimator depends on the validity of the instruments. To address this issue, we consider two specification tests suggested by Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998). The first is a Sargan test of over-identifying restrictions, which tests the overall validity of the instruments by analysing the sample analogue of the moment conditions used in the estimation process. The second test examines the hypothesis that the error term $\epsilon_{i,t}$, is not serially correlated. To eliminate the firm specific effect the first difference of all the variables are considered for the estimation.

6. Discussion of results

We use Im et al.'s (2003) and Levin et al.'s (2002) tests of Stationarity, which allowed us to test the null hypothesis of the unit root for the whole panel against the alternative hypothesis that there is at least one stationary series in the panel. Table 5 presents the result of panel unit-root test of the variables such as CR, CAR NPA, LLR and ZRISK for all the commercial banks across the ownership. The result shows that all the variables are stationary at level I(0).

Table 5. Panel unit-root test results		
Variables	IM, Pesaran and Shin	Levin-Lin-Chu
Public-sector Banks		
CR	-11.90(0.000)***	-17.20(0.000)***
CAR	-3.1057(0.0009)***	-3.0374(0.0012)***
NPA	-3.2867(0.0005)***	-6.8907(0.0000)***
LLR	-3.96(0.000)***	-2.45(0.0070)***
ZRISK	-2.3495(0.0094)**	-2.0323(0.0211)**
Private banks		
CR	-13.43(0.0000)***	-34.23(0.0000)***
CAR	-1.6094(0.0538)**	-2.6054(0.0046)*
NPA	-8.6780(0.0000)***	-20.3603(0.0000)***
LLR	-2.67(0.0038)**	-2.49(0.0062)**
ZRISK	-3.9084(0.0000)***	-1.4040(0.0402)**
Foreign banks		
CR	-15.87(0.0000)***	17.12(0.0008)***
CAR	-3.8004(0.0001)***	-7.6917(0.0000)***
NPA	-2.9723(0.0015)***	-7.8403(0.0000)***
LLR	-1.54(0.0006)***	-2.47(0.0067)**

Notes: Number in the parenthesis shows the p -values.
 ***Significance at 5% level and **significance at 1% level.

Table 6. Results of DH causality test of risk and capital ratios

Null hypothesis	W-Stat	Zbar-Stat	Prob Value
Panel A: Causality between risk and capital ratio for public-sector banks			
NPA doesn't homogeneously cause CR	8.2834	9.7231	0.0000
CR doesn't homogeneously cause NPA	3.2089	1.2665	0.2032
LLR doesn't homogeneously cause CR	3.7011	2.1039	0.0355
CR doesn't homogeneously cause LLR	2.6076	0.2750	0.7845
Panel B: Causality between risk and capital ratio for private-sector banks			
NPA doesn't homogeneously cause CR	8.6934	8.6512	0.0000
CR doesn't homogeneously cause NPA	2.7439	4.5637	0.1251
LLR doesn't homogeneously cause CR	1.1275	2.0198	0.0000
CR doesn't homogeneously cause LLR	3.3845	1.1437	0.1523
Panel C: Causality between risk and capital ratio for foreign banks			
NPA doesn't homogeneously cause CR	7.5776	8.3419	0.0000
CR doesn't homogeneously cause NPA	3.5231	2.1380	0.2530
LLR doesn't homogeneously cause CR	5.2346	3.5712	0.0379
CR doesn't homogeneously cause LLR	2.3098	1.1098	0.3310
Panel A: Causality between risk and capital adequacy ratio for public sector banks			
NPA doesn't homogeneously cause CAR	9.2423	5.4564	5E-08
CAR doesn't homogeneously cause NPA	5.2833	1.3358	0.1816
LLR doesn't homogeneously cause CAR	3.2713	2.1739	0.0796
CAR doesn't homogeneously cause LLR	2.6025	0.2712	0.7845
Panel B: Causality between risk and capital adequacy ratio for private Sector Banks			
NPA doesn't homogeneously cause CAR	5.9667	1.7032	0.0885
CAR doesn't homogeneously cause NPA	3.3595	-0.5546	0.5792
LLR doesn't homogeneously cause CAR	2.7865	3.4635	0.0642
CAR doesn't homogeneously cause LLR	3.8812	0.6112	0.8935
Panel C: Causality between risk and capital adequacy ratio for foreign Banks			
NPA doesn't homogeneously cause CAR	3.6427	1.8754	0.0607
CAR doesn't homogeneously cause NPA	1.8841	-0.8768	0.3806
LLR doesn't homogeneously cause CAR	3.5812	2.1635	0.0051
CAR doesn't homogeneously cause NPA	2.3452	0.09843	0.4671

Note: Authors own calculation.

The results of panel granger causality are presented in Tables 6 and 7. More specifically, Table 6 shows the panel granger causality results of risk and CAR and Table 7 shows the results of risk and capital ratio. Our results indicate that for all the risk proxies, unidirectional causality exists between bank capital and risk, i.e. bank risk granger cause bank capital.

After identifying the unidirectional causality from bank risk to bank capital ratio we explore the explanatory power of bank risk on capital ratio determination with other control variables using the GMM approach. Table 7 shows the GMM estimation results of the impact of bank risk and other bank-specific variables on bank capital determination. The p-values of z_2 test statistics indicate that very little unobserved firm specific effects exist in the estimation results. Sargan test results for over-identifying restrictions conclude that the instruments used in the estimation are valid. The Wald test results confirm the significance of explanatory variables in explaining the dependent variable.

The significant positive coefficient of lagged capital ratio implies that current capital ratio depends on past capital ratio (i.e. there has been a persistence effect in banks' capital ratio

Table 7. GMM estimation results in the whole period (1997–2014)

Variables	Public sector Banks		Private-sector banks		Foreign banks	
Panel A: Dependent variable: Capital ratio (total capital/total assets)						
ΔCR_{t-1}	0.76*** (23.97)	0.77*** (27.61)	0.58*** (20.15)	0.57*** (9.91)	0.54*** (11.76)	0.54*** (5.36)
ΔNPA	0.36** (1.99)		0.23* (2.31)		0.12** (2.43)	
ΔLLR		0.23** (3.08)		-0.06** (-1.99)		-0.04** (-2.58)
SZ	-0.09 (-0.36)	-0.14 (-1.12)	-0.41*** (-3.27)	-0.45*** (-2.60)	-6.64** (-5.04)	-6.82** (-2.63)
NIM	-0.12** (-2.31)	-0.18** (-2.59)	0.008** (2.02)	0.16** (3.12)	-0.13** (-2.93)	-0.14** (-2.16)
LAR	-0.02** (-1.67)	-0.01 (-1.37)	0.01 (1.45)	0.01 (1.35)	0.04 (1.27)	0.04 (1.38)
BL	0.01*** (4.40)	0.01*** (5.67)	-0.002 (-0.17)	-0.0003 (0.01)	0.009 (0.79)	0.009 (1.60)
RP	0.82 (1.03)	0.86 (1.30)	-0.09 (-0.19)	-0.05 (-0.32)	-2.93 (-0.81)	-2.60 (-0.58)
Wald test	$\chi^2(7) = 356.25$ (0.00)	$\chi^2(7) = 680.58$ (0.000)	$\chi^2(7) = 233.59$ (0.000)	$\chi^2(7) = 626.05$ (0.000)	$\chi^2(7) = 309.90$ (0.000)	$\chi^2(7) = 664.80$ (0.000)
Z_2 test	1.71(0.18)	1.56(0.11)	1.13(0.17)	1.18(0.23)	1.17(0.16)	1.80(0.22)
Sargan test	$\chi^2(135) = 201.84$ (0.12)	$\chi^2(135) = 213.80$ (0.18)	$\chi^2(135) = 149.09$ (0.18)	$\chi^2(135) = 185.17$ (0.13)	$\chi^2(135) = 217.34$ (0.17)	$\chi^2(135) = 179.11$ (0.15)
NOB	416	416	288	288	384	384
Panel B: Dependent variable: Capital adequacy ratio (total capital/risk Weighted Assets)						
ΔCAR_{t-1}	0.51*** (9.01)	0.64*** (11.38)	0.40*** (6.28)	0.41*** (6.49)	0.57*** (12.78)	0.61*** (14.43)

(Continued)

Table 7. (Continued)

Variables	Public sector Banks		Private-sector banks		Foreign banks	
Δ NPA	0.20** (5.55)	2.12** (2.89)	0.29* (1.77)	-0.47* (-2.34)	0.50** (1.77)	-0.52** (-2.08)
Δ LLR	-0.41 (-0.88)	-0.63 (-1.23)	-1.64*** (-3.48)	-1.36*** (-3.15)	-13.45** (-1.92)	-9.03 (-1.30)
SZ	-0.36** (-2.19)	-0.36** (-2.02)	1.40*** (7.37)	1.43*** (7.49)	-0.07** (-2.37)	-0.43** (-1.77)
LAR	-0.04** (-1.97)	-0.006 (-0.03)	-0.01 (-0.81)	-0.02 (-1.24)	-0.09 (-0.56)	-0.07 (-0.45)
BL	0.02** (2.46)	0.01** (3.00)	0.008 (1.39)	0.01 (1.58)	-0.004 (-0.36)	-0.007 (-0.57)
RP	-3.73*** (-6.11)	-4.83*** (-7.46)	-4.26** (-2.05)	-4.00** (-1.92)	-61.52*** (-3.38)	-61.50*** (-3.45)
Wald test	$\chi^2(7) = 495.77$ (0.00)	$\chi^2(7) = 399.1$ (0.00)	$\chi^2(7) = 176.36$ (0.00)	$\chi^2(7) = 173.23$ (0.00)	$\chi^2(7) = 269.30$ (0.00)	$\chi^2(7) = 264.80$ (0.00)
Z ₂ test	1.05(0.29)	1.12(0.25)	1.51(0.12)	1.54(0.12)	1.15(0.24)	1.23(0.21)
Sargan test	$\chi^2(135) = 170.70$ (0.12)	$\chi^2(135) = 169.10$ (0.12)	$\chi^2(135) = 149.09$ (0.19)	$\chi^2(135) = 152.41$ (0.19)	$\chi^2(135) = 163.69$ (0.14)	$\chi^2(135) = 171.44$ (0.14)
NOB	416	416	288	288	384	384

Notes: Authors own calculation. For GMM each variable is in its first difference form. ***, **, * show the 1, 5 and 10% level of significance, respectively. Figures in the bracket show the Z-statistics. Wald test is a test of joint significance of the estimated coefficients, which is asymptotically distributed as chi-square under the null of no relationship and Sargan test of over identifying restrictions, which is asymptotically distributed as chi-square under the null of instrumental validity.

determination). The results indicate that the coefficient of NPA is statistically significant and positive for all the three types of banks for both the bank capital ratios. This validates that banks having more credit risk desire to hold more capital to avoid the bankruptcy and liquidation costs in India. Furthermore, we observe that the association between changes in risk and changes in capital is different while measuring the risk through loan loss reserves. Although for public-sector banks the relationship is positive, but for private and foreign banks the impact of change in risk on change in capital is negative. This could be due to the fact that both private and foreign banks operating in India use their capital as loan loss reserves to avoid the insolvency and liquidation costs. It can be also argued that due to reputation, market presence, and better diversification these banks may be able to maintain adequate capital ratio to avoid the regulatory costs. However, the result is consistent for public-sector banks for both the risk proxies that increase in risk leads to increase in capital and the association between LLR and capital differs for private and foreign banks.

The size of the bank has negative and significant impact on capital ratios of commercial banks. This is consistent with the too-big-to fail hypothesis that large banks hold relatively less capital than the small banks due to lesser probability of failure. These findings are also consistent with other studies (Jacques & Nigro, 1997; Kleff & Weber, 2008; Shrieves & Dahl, 1992). Our empirical findings suggest that NIM has a significant and negative impact on both the measure of capital ratio in the case of public-sector banks and foreign banks. It implies that high earning value motivates bank managers to raise more equity capital and take self-incentive to minimise risk taking (Saunders & Wilson, 2001). We find a positive relationship between NIM and capital ratios for private banks. This finding supports the argument that high NIM may allow the banks to raise additional capital through retained earnings (Rime, 2001). This finding is supported by Kleff and Weber (2008) and Mili, Sahut, and Trimeche (2014).

We further find that there is a significant negative relationship between LAR and both the measures of capital ratios only in the case of public-sector banks. This is consistent with the argument that increase in LAR may decline the liquidity and increase the probability of default, which in turn reduces the amount of equity capital. The result reveals that regression coefficient of BL is significant only in the case of public-sector banks. This implies that as liquidity increases the cash and cash equivalent also increase, which further may be used to raise the equity in the case of public-sector banks in India, as they are investing more in equity than the private and foreign banks. We find the RP is statistically significant and negative for all type of banks for determination of CAR, which imply that banks approaching to regulatory minimum CAR may have an incentive to increase capital and reduce risk in order to avoid the regulatory cost. The regression coefficient of RP is insignificant for capital ratio (Capital to asset ratio) determination. Our result is consistent with Ahmad et al. (2008), Jacques and Nigro (1997) and Das and Ghosh (2004). More specifically, it indicates that adequately capitalised banks decrease their capital ratio more prominently than other banks.

Furthermore, this study tries to find out the impact of financial crisis on bank capital ratio of commercial banks in India. Though Indian banking sector was resilient at the time of Global financial crisis, but private banks and foreign banks experienced a slower deposit growth during the year 2007–08 (Eichengreen & Gupta, 2013). Again, public-sector banks specially State Bank of India experiences increase in deposit growth because of Government guarantee at the time of crisis. Considering this fact further this study tries to identify the significance of financial crisis in determining the capital ratios of commercial banks in two different periods, i.e. period without financial crisis (1997–98 to 2006–07) and period with financial crisis (2007–08 to 2013–14). Tables 8 and 9 show the GMM estimation results of the impact of risk and other variables on CAR and capital ratio, respectively.

The results reveal that the impact of NPA on capital ratio is positive and significant for public-sector banks, but the impact is more in the crisis period than the non-crisis period. We find similar

Table 8. GMM estimation results of capital ratio determination in the periods with and without crisis

Variables	Public-sector banks		Private-sector banks		Foreign banks	
	Capital ratio (without crisis period 1997-2007)					
ΔCR_{t-1}	0.77*** (18.14)	0.76*** (19.04)	0.59*** (11.46)	0.48 (8.60)	0.50*** (6.500)	0.52*** (3.41)
ΔNPA	0.04** (1.94)		-0.006 (-0.35)		0.03 (0.53)	
ΔLLR		0.12** (2.18)		-0.09** (-1.96)		-0.13 (-2.47)
SZ	0.26 (0.39)	0.21 (0.31)	-0.45 (-1.54)	-0.50 (-1.58)	-15.67*** (-5.58)	-16.39*** (-2.95)
NIM	0.27 (-1.33)	-0.34** (-1.71)	0.002 (0.04)	-0.02 (-0.19)	0.08 (1.24)	0.07 (1.61)
LAR	-0.01 (-1.01)	-0.02** (-1.41)	0.012* (1.87)	0.01 (1.27)	0.07 (1.18)	0.06 (0.95)
BL	-0.02 (-4.59)	-0.02*** (-3.06)	-0.004 (-0.19)	0.0002 (0.08)	0.01** (3.84)	0.01** (2.62)
RP	0.69 (1.33)	0.94 (1.64)	-0.07 (-0.12)	-0.04 (-0.22)	-3.98 (-1.16)	-4.44 (-1.17)
Wald test	$\chi^2(7) = 451.33$ (0.00)	$\chi^2(7) = 893.31$ (0.00)	$\chi^2(7) = 447.09$ (0.000)	$\chi^2(7) = 620.39$ (0.000)	$\chi^2(7) = 126.65$ (0.000)	$\chi^2(7) = 620.39$ (0.000)
Z ₂ test	1.45 (0.14)	1.39 (0.16)	1.16(0.24)	1.26(0.20)	2.53(0.11)	2.68(0.17)
Sargan test	$\chi^2(44) = 67.85$ (0.29)	$\chi^2(44) = 115.79$ (0.23)	$\chi^2(44) = 60.40$ (0.15)	$\chi^2(44) = 59.80$ (0.19)	$\chi^2(44) = 76.12$ (0.19)	$\chi^2(44) = 77.17$ (0.15)
NOB	233	233	162	162	216	216
With crisis period: 2008-2014						
ΔCR_{t-1}	0.33*** (3.46)	0.30** (2.52)	0.63*** (4.63)	0.62*** (4.15)	0.15*** (5.84)	0.14*** (5.29)

(Continued)

Table 8. (Continued)

Variables	Public-sector banks		Private-sector banks		Foreign banks	
ΔNPA	0.05* (1.79)		0.12*** (4.55)		0.07 (0.21)	
ΔLLR		0.13** (2.77)		-0.06* (-1.75)		-0.15** (-2.17)
SZ	-0.98*** (-3.37)	-0.77** (-2.41)	-0.36** (-2.51)	-0.35** (-2.18)	-11.32*** (4.28)	-11.08** (-2.06)
NIM	0.23*** (3.19)	0.18** (1.87)	0.01 (0.32)	0.06 (1.13)	0.001 (0.27)	0.001 (0.10)
LAR	0.01 (1.36)	0.003 (1.51)	0.001 (0.26)	-0.004 (-0.77)	-0.07 (-1.17)	-0.06 (-1.27)
BL	0.005 (0.45)	0.0009 (0.10)	-0.0007 (-0.27)	0.001 (0.47)	-0.008 (-0.23)	0.006 (-0.47)
RP	-0.04 (-0.19)	-0.02 (-0.58)	0.04 (0.27)	-0.03 (0.23)	2.96 (0.40)	3.11 (1.54)
Wald test	$\chi^2(7) = 52.18$ (0.000)	$\chi^2(7) = 22.30$ (0.000)	$\chi^2(7) = 110.04$ (0.000)	$\chi^2(7) = 83.48$ (0.000)	$\chi^2(7) = 16.08$ (0.000)	$\chi^2(7) = 98.81$ (0.000)
Z ₂ test	1.07 (0.28)	1.18 (0.22)	1.37 (0.71)	1.22 (0.56)	1.63 (0.10)	1.61 (0.15)
Sargan test	$\chi^2(14) = 58.38$ (0.16)	$\chi^2(14) = 47.19$ (0.21)	$\chi^2(14) = 43.17$ (0.11)	$\chi^2(14) = 37.67$ (0.16)	$\chi^2(14) = 14.60$ (0.40)	$\chi^2(14) = 14.56$ (0.39)
NOB	130	130	90	90	120	120

Notes: Authors own calculation. For GMM each variable is in its first difference form. ***, **, * show the 1, 5 and 10% level of significance, respectively. Figures in the bracket show the Z-statistics. Wald test is a test of joint significance of the estimated coefficients, which is asymptotically distributed as chi-square under the null of no relationship and Sargan test of over identifying restrictions, which is asymptotically distributed as chi-square under the null of instrumental validity.

Table 9. GMM estimation results of capital adequacy ratio determination in the periods with and without crisis

Variables	Public-sector banks		Private-sector banks		Foreign banks	
	Dependent variable: Capital adequacy ratio (without crisis Period:1997–2007)					
ΔCAR_{t-1}	0.46*** (5.46)	0.52*** (6.38)	0.22** (2.71)	0.20*** (11.55)	0.15** (2.32)	0.16** (2.40)
ΔNPA	0.08** (2.50)		0.14* (1.98)		0.18** (2.27)	
ΔLLR		0.28** (2.47)		-0.06** (-2.37)		-0.45** (-2.40)
SZ	-2.66** (-2.57)	-3.73*** (-3.78)	-1.08 (-1.24)	-0.42 (-0.52)	-8.16*** (-5.68)	-8.62*** (-5.95)
NIM	0.10 (0.32)	0.25 (0.74)	1.79*** (6.44)	1.73*** (6.23)	0.57* (1.76)	0.51 (1.60)
LAR	-0.07** (-3.25)	-0.06** (-2.53)	-0.03 (-1.27)	-0.03 (-1.53)	0.25 (-0.93)	-0.30 (-1.12)
BL	-0.01 (-1.14)	-0.008 (-0.07)	0.004 (0.47)	0.002 (0.31)	0.001 (-0.75)	-0.01 (-0.59)
RP	-4.53*** (-6.33)	-4.85*** (-6.56)	-5.39** (-2.59)	-4.88** (-2.39)	67.41*** (-4.01)	-72.26*** (-4.23)
Wald test	$\chi^2(7) = 248.96$ (0.000)	$\chi^2(7) = 218.11$ (0.000)	$\chi^2(7) = 51.69$ (0.000)	$\chi^2(7) = 49.04$ (0.000)	$\chi^2(7) = 75.34$ (0.000)	$\chi^2(7) = 77.75$ (0.000)
Z ₂ test	1.31(0.22)	0.44(0.65)	1.22(0.21)	1.28(0.19)	1.15(0.24)	1.17(0.22)
Sargan test	$\chi^2(44) = 75.65$ (0.21)	$\chi^2(44) = 67.85$ (0.29)	$\chi^2(44) = 52.21$ (0.18)	$\chi^2(44) = 58.29$ (0.17)	$\chi^2(44) = 44.55$ (0.44)	$\chi^2(44) = 46.30$ (0.37)
NOB	233	233	162	162	216	216
With crisis period:2008–2014						
ΔCAR_{t-1}	0.56** (3.39)	0.61*** (4.43)	0.65*** (5.97)	0.25*** (5.26)	0.17** (2.49)	0.17*** (6.52)

(Continued)

Table 9. (Continued)

Variables	Public-sector banks		Private-sector banks		Foreign banks	
ΔNPA	0.10** (2.60)		1.21** (2.72)		0.27*** (3.44)	
ΔLLR		0.13** (2.59)		-0.60** (-2.01)		-0.87** (-1.99)
SZ	-5.10*** (-4.01)	-5.42*** (-6.93)	-2.73*** (-4.54)	-3.48*** (-3.43)	-25.38** (-3.30)	-24.61*** (-3.26)
NIM	0.93* (2.84)	1.03*** (3.13)	0.40 (0.91)	0.53 (1.21)	0.02** (2.33)	0.02** (2.33)
LAR	-0.008 (-0.17)	0.009 (0.02)	0.001 (0.03)	0.004 (0.10)	-0.18* (-1.71)	-0.21* (-1.87)
BL	-0.05 (-1.10)	-0.04 (-0.77)	-0.03 (-1.20)	-0.03 (-1.44)	-0.03*** (-5.01)	-0.03*** (-5.12)
RP	-1.35** (-2.33)	-1.39** (-6.00)	-1.50 (-1.08)	-1.89 (-1.40)	18.74 (1.37)	17.85 (1.31)
Wald test	$\chi^2(7) = 143.67$ (0.000)	$\chi^2(7) = 461.04$ (0.000)	$\chi^2(7) = 12.50$ (0.08)	$\chi^2(7) = 16.92$ (0.00)	$\chi^2(7) = 94.07$ (0.00)	$\chi^2(7) = 94.96$ (0.00)
Z ₂ test	0.29(0.26)	1.31(0.18)	1.68(0.39)	1.08(0.27)	-1.38(0.16)	-1.54(0.12)
Sargan test	$\chi^2(14) = 17.10$ (0.25)	$\chi^2(14) = 51.68$ (0.16)	$\chi^2(14) = 17.19$ (0.24)	$\chi^2(14) = 17.19$ (0.27)	$\chi^2(14) = 68.96$ (0.13)	$\chi^2(14) = 67.90$ (0.10)
NOB	130	130	90	90	120	120

Notes: Authors own calculation. For GMM each variable is in its first difference form. ***, **, * show the 1, 5 and 10% level of significance, respectively. Figures in the bracket show the Z-statistics. Wald test is a test of joint significance of the estimated coefficients, which is asymptotically distributed as chi-square under the null of no relationship and Sargan test of over identifying restrictions, which is asymptotically distributed as chi-square under the null of instrumental validity.

results for private-sector and foreign banks also. The relationship between LLR and capital ratios is found to be same in the whole period result. The effects of other bank-specific variables on capital ratios are more or less similar with the whole period analysis. This implies that although the relative importance of certain variables including the bank risk proxies varies across the periods, the significance of bank risk sustains in both the periods, which proves the strong relationship between bank risk and capital in the case of Indian banks.

7. Robustness Check

The robustness of the results on the relationship between bank risk and bank capital has been carried out considering another alternative risk proxy (i.e. ZRISK). As the data for calculation of ZRISK for foreign banks is not available, this analysis has been carried out only for public- and private-sector banks only.

The results presented in Table 10 indicate that unidirectional causality exists between bank capital and ZRISK, i.e. ZRISK granger cause bank capital. After getting the unidirectional causality between ZRISK and Capital, we try to find out the impact of ZRISK on capital by using GMM approach. The results are reported in Table 11. A low ZRISK implies a riskier bank and a higher ZRISK implies a safer bank. Therefore, the negative regression coefficient of ZRISK indicates a positive relationship between risk and capital and the positive coefficient implies a negative relationship. The results reported in Table 11 reveal that there has been a positive relationship between bank risk and capital for both public- and private-sector banks. This result is consistent with the findings of other risk proxies like NPA and LLR. Our result is also consistent with previous studies (Ahmad et al., 2008; Kleff & Weber, 2008; Shrieves & Dahl, 1992).

Table 12 presents the GMM estimation results of the impact of ZRISK on capital ratios in two different periods classified on the basis of financial crisis. The results are also more or less similar with the previous findings that the effect of risk on bank capital ratio has been more on the crisis period than the non-crisis period. The nature of impact and the significance level of other bank-specific variables are also same in this case. These findings validate the fact that bank risk significantly determines the bank capital ratio of all types of commercial banks operating in India.

8. Conclusions

This study establishes the dynamic relationship between bank capital and risk by considering three types of commercial banks such as public-sector banks, private-sector banks and foreign banks operating in India during the period from 1997 to 2014. From the preliminary analysis we find that bank capital ratio varies across the subsamples classified on the basis of ownership, asset size, profitability and NPA. The panel Granger Causality test results reveal that there is a unidirectional

Table 10. Result of DH causality test of risk and capital ratios			
Causality between risk and capital ratio for public-sector and private sector banks			
ZRISK doesn't homogeneously cause CR	3.8734	2.3893	0.0171
CR doesn't homogeneously cause ZRISK	3.2091	1.2678	0.2063
ZRISK doesn't homogeneously cause CR	8.4687	8.3392	0.0000
CR doesn't homogeneously cause ZRISK	3.1283	1.4763	0.3941,
Causality between risk and capital adequacy ratio for public-sector and private sector banks			
Null hypothesis	W-Stat	Zbar-Stat	Prob Value
ZRISK doesn't homogeneously cause CAR	2.5365	3.7130	0.0002
CAR doesn't homogeneously cause ZRISK	1.0348	-0.3572	0.7209
ZRISK doesn't homogeneously cause CAR	4.3562	7.1934	6E-13
CAR doesn't homogeneously cause ZRISK	0.8292	-0.7610	0.4466

Note: Authors own calculation.

Table 11. GMM estimation result for ZRISK

Variables	Public-sector banks		Private sector banks	
	CR	CAR	CR	CAR
ΔCR_{t-1}	0.77*** (25.36)		0.47*** (9.61)	
ΔCAR_{t-1}		0.51*** (7.49)		0.43*** (6.69)
$\Delta ZRISK$	-0.12** (-2.57)	-0.61*** (-8.54)	-0.06** (-2.71)	-0.12* (-1.73)
SZ	0.17 (0.51)	0.24 (0.53)	0.41** (3.62)	1.03** (2.14)
NIM	-0.15 (-1.22)	-0.30* (-1.88)	0.26 (1.17)	1.41*** (7.34)
LAR	-0.02* (-1.76)	-0.02* (-2.25)	0.01 (0.66)	-0.01 (-0.85)
BL	0.01*** (6.47)	0.01 (1.02)	-0.002 (-0.20)	-0.009 (-1.45)
RP	0.94 (1.30)	-4.58*** (-7.98)	-0.04 (-0.09)	-4.04** (-1.93)
Wald test	$\chi^2(7) = 305.43$ (0.000)	$\chi^2(7) = 563.50$ (0.000)	$\chi^2(7) = 241.22$ (0.000)	$\chi^2(7) = 173.48$ (0.000)
Z ₂ test	1.94(0.15)	0.96(0.33)	1.17(0.21)	1.49(0.13)
Sargan test	$\chi^2(135) = 383.14$ (0.23)	$\chi^2(135) = 402.78$ (0.13)	$\chi^2(135) = 127.68$ (0.24)	$\chi^2(135) = 145.72$ (0.24)
NOB	416	416	288	288

Notes: Authors own calculation. For GMM each variable is in its first difference form. ***, **, * show the 1, 5 and 10% level of significance, respectively. Figures in the bracket show the Z-statistics. Wald test is a test of joint significance of the estimated coefficients, which is asymptotically distributed as chi-square under the null of no relationship and Sargan test of over identifying restrictions, which is asymptotically distributed as chi-square under the null of instrumental validity.

causality exists between bank capital and risk. This implies that risk is causing capital in the case of public, private and foreign banks. However, we do not find sufficient evidence in favour of reverse causality. From the GMM estimation results, we find a positive association between bank risk measured through NPA and bank capital for all the three types of commercial banks during the sample period. Our result is supported by the regulatory costs and bankruptcy cost avoidance hypothesis and managerial risk aversion arguments (Rime, 2001; Shrieves & Dahl, 1992). While evaluating the impact of risk (LLR) on capital ratio, we observe that increase in risk leads to increase in bank capital for public-sector banks, but we find the opposite relationship for private and foreign banks. This indicates that the result is consistent for public-sector banks for both the risk proxies that increase in risk leads to increase in capital. However, the association between LLR and capital differs for private and foreign banks. This could be because of the fact that these banks are using their capital as LLR at the time of increasing risk as they have already a high amount of capital ratio. Another probable reason could be that they can easily raise capital from the market due to better diversification and ability to take more risk by investing major funds in loans with the aim of getting high profit. Our result is also supported by Das and Ghosh (2004; Jacques & Nigro, 1997; Lindquist, 2004). Furthermore, this study finds that the bank-specific factors such as size, NIM, LAR and RP play the significant role in the determination of the capital ratio across the different types of commercial banks. Finally, we examine the impact of risk on bank capital across the periods classified on the basis of occurrence of financial crisis. We find that the rate of increase in capital is more during the financial crisis in comparison to normal market conditions.

Table 12. GMM estimation result in with and without crisis period

Variables	Public-sector banks						Private-sector banks					
	CR		CAR		CR		CAR		CR		CAR	
	Without Crisis	With Crisis	Without Crisis	With Crisis	Without Crisis	With Crisis	Without Crisis	With Crisis	Without Crisis	With Crisis	Without Crisis	With Crisis
ΔCR_{t-1}	0.78*** (23.43)	0.31** (1.93)			0.43*** (5.78)	0.55*** (4.02)						
ΔCAR_{t-1}			0.48*** (6.35)	0.56*** (3.39)							-0.94*** (5.53)	0.24** (2.95)
$\Delta ZRISK$	-0.32** (-2.39)	-0.62** (-1.96)	-0.48*** (-4.63)	-0.56* (-1.77)	-0.02*** (-2.56)	-0.14* (-1.97)					-0.22** (-2.72)	-0.53** (-1.88)
SZ	0.01 (0.04)	-0.96** (-2.96)	2.42** (2.64)	-4.56** (-4.11)	-0.45 (-1.75)	-0.40*** (-2.98)					-0.96 (-1.01)	-1.89* (-1.71)
NIM	-0.35 (-1.38)	0.23** (2.44)	0.08 (0.26)	0.82** (2.57)	0.03 (0.40)	0.09* (1.71)					1.68*** (6.17)	0.57 (1.32)
LAR	-0.02 (-1.30)	0.01* (1.76)	-0.062** (-2.71)	-0.009 (-0.20)	0.01 (1.56)	-0.003 (-1.06)					-0.01 (-0.47)	-0.01 (-0.32)
BL	-0.03 (-9.04)	0.002 (0.29)	-0.008 (-0.89)	-0.04 (-0.95)	-0.001 (0.30)	0.002 (0.98)					0.004 (0.50)	-0.02 (-1.02)
RP	0.93 (1.56)	-0.02 (-0.68)	-4.67*** (-6.96)	-1.46* (-1.51)	0.01 (0.08)	0.05 (1.10)					-5.36** (-2.58)	-1.65 (-1.22)
Wald test	$\chi^2(7) = 598.40$ (0.00)	$\chi^2(7) = 20.87$ (0.000)	$\chi^2(7) = 55.12$ (0.000)	$\chi^2(7) = 163.01$ (0.000)	$\chi^2(7) = 552.41$ (0.000)	$\chi^2(7) = 90.04$ (0.000)					$\chi^2(7) = 55.12$ (0.000)	$\chi^2(7) = 16.85$ (0.01)
Z ₂ test	1.58 (0.11)	1.27(0.20)	1.06(0.28)	0.14(0.17)	1.14(0.25)	1.06(0.28)					1.06(0.28)	1.44(0.65)
Sargan test	$\chi^2(44) = 86.31$ (0.20)	$\chi^2(14) = 52.78$ (0.19)	$\chi^2(44) = 49.23$ (0.27)	$\chi^2(14) = 17.64$ (0.23)	$\chi^2(44) = 61.09$ (0.14)	$\chi^2(14) = 41.36$ (0.12)					$\chi^2(44) = 49.23$ (0.27)	$\chi^2(14) = 14.91$ (0.38)
NOB	233	130	233	130	162	90					162	90

Notes: Authors own calculation. For GMM each variable is in its first difference form. ***, ** * show the 1, 5 and 10% level of significance, respectively. Figures in the bracket show the Z-statistics. Wald test is a test of joint significance of the estimated coefficients, which is asymptotically distributed as chi-square under the null of no relationship and Sargan test of over identifying restrictions, which is asymptotically distributed as chi-square under the null of instrumental validity.

This study has certain theoretical and practical policy implications for commercial banks. Taking a cue from the positive impact of risk on capital, commercial bankers may focus on reduction of portfolio risk to maintain adequate amount of capital as it is essential for profit maximisation and sustenance. Furthermore, we observe that private and foreign banks are reducing their capital base by increasing the loan loss reserve in the anticipation of high risk. This may create a problem to maintain the minimum regulatory capital as raising capital from the market may not be possible at the time of requirements. This could be because of the fact that Indian capital market is not a developed and raising capital from the market is not easier particularly in times of market bubbles. Therefore, the regulators and managers should be concerned about the maintenance of capital according to changes in risk in the case of private and foreign banks. One of the logical extensions of this study could be the incorporation of co-operative banks along with other commercial banks operating in India.

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References

- Aggarwal, R., & Kevin, T. J. (1998). Assessing the impact of prompt corrective action on bank capital and risk. *FRBNY Economic Policy Review*, 4, 23–32.
- Ahmad, R., Ariff, M., Skully, J., & Michael, L. (2008). The determinants of bank capital ratios in a developing economy. *Asia Pacific Financial Market*, 15, 255–272. doi:10.1007/s10690-009-9081-9
- Alfon, I., Argimon, I., & Bascunana-Ambros, P. (2004). What Determines How Much Capital is held by UK Banks and Building Societies? Retrieved from <http://www.bde.es/ff/webbde/SES/Secciones/Publicaciones/PublicacionesSeridas/DocumentosTrabajo/05/Fic/dt0515e.pdf>.
- Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The Review of Economics Studies*, 58(2), 277–297. doi:10.2307/2297968
- Arellano, M., & Bover, O. (1995). Another look at the instrumental-variable estimation of error-components models. *Journal of Econometrics*, 68, 29–52. doi:10.1016/0304-4076(94)01642-D
- Ayuso, J., Perez, D., & Saurina, J. (2004). Are capital buffers procyclical? Evidence from Spanish panel data. *Journal of Financial Intermediation*, 13, 249–264. doi:10.1016/S1042-9573(03)00044-5
- Blundell, R. W., & Bond, S. R. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, 87, 115–143. doi:10.1016/S0304-4076(98)00009-8
- Buyuksalvarci, A., & Abdioglu, H. (2011). Determinants of capital adequacy ratio in Turkish's banks: A panel data analysis. *African Journal of Business Management*, 5, 11199–11209.
- Das, A., & Ghosh, S. (2004). The relationship between Risk and Capital: Evidence from Indian public sector banks. Retrieved from <http://econwpa.repec.org/eps/io/papers/0410/0410006.pdf>.
- Dumitrescu, E., & Hurlin, C. (2012). Testing for granger non-causality in heterogeneous panels. *Economic Modelling*, 29(4), 1450–1460. doi:10.1016/j.econmod.2012.02.014
- Ediz, T., Michael, I., & Perraudin, W. (1998). The impact of capital requirements on U.K. bank behaviour. *Economic Policy Review*, 4, 15–22.
- Eichengreen, B., & Gupta, P. (2013). The financial crisis and Indian banks: Survival of the fittest. *Journal of International Money and Finance*, 39, 138–152.
- Ghosh, S., Nachene, D. M., Narain, A., & Sahoo, S. (2003). Capital requirement and bank behaviour: An empirical analysis of Indian public sector banks. *Journal of International Development*, 15, 145–156. doi:10.1002/jid.947
- Gropp, R., & Heider, F. (2007). What can corporate governance say about banks' capital structure? Retrieved from <http://www.wiwi.uni-frankfurt.de/schwerpunkte/finance/master/>.
- Hannan, T. H., & Hanweck, G. A. (1988). Bank insolvency risk and the market for large certificates of deposit. *Journal of Money, Credit and Banking*, 20, 203–211. doi:10.2307/1992111
- Hussain, E. M., & Hassan, K. M. (2005). Basel capital requirements and bank credit risk taking in developing countries. University of New Orleans Department of Economics and Finance, (Working Paper No. 2001–2005)
- Im, K. S., Pesaran, M. H., & Shin, Y. (2003). Testing for unit roots in heterogeneous panels. *Journal of Econometrics*, 115, 53–74. doi:10.1016/S0304-4076(03)00092-7
- Jacques, K., & Nigro, P. (1997). Risk-based capital, portfolio risk, and bank capital: A simultaneous equation approach. *Journal of Economics and Business*, 49, 533–547. doi:10.1016/S0148-6195(97)00038-6
- Jokipii, T., & Milne, A. (2008). The cyclical behaviour of European bank capital buffer". *Journal of Banking and Finance*, 32, 1440–1451. doi:10.1016/j.jbankfin.2007.12.001
- Kleff, V., & Weber, M. (2008). How do banks determine capital? Evidence from Germany. *German Economic Review*, 9, 354–372. doi:10.1111/geer.2008.9.issue-3
- Levin, A., Lin, C. F., & Chu, C. S. J. (2002). Unit root test in panel data: Asymptotic and finite sample properties. *Journal of Econometrics*, 108, 1–24. doi:10.1016/S0304-4076(01)00098-7
- Lindquist, K. (2004). Banks buffer capital: How important is risk. *Journal of International Money and Finance*, 23, 493–513. doi:10.1016/j.jimonfin.2004.01.006
- Milli, M., Sahut, J. M., & Trimeche, H. (2014). Determinants of the Capital Adequacy Ratio of a Foreign Bank's

- Subsidiaries: The Role of the Interbank Market and Regulation of Multinational Banks. Retrieved from https://www.ipag.fr/wp-content/uploads/recherche/WP/IPAG_WP_2014_366.pdf.
- Mpuga, P. (2002). The 1998–99 banking crisis in Uganda: What was the role of the new capital requirements? *Journal of Financial Regulation and Compliance*, 10, 224–242. doi:10.1108/13581980210810229
- Nachane, D. M., Narain, A., Ghosh, S., & Sahoo, S. (2000). Capital Adequacy Requirements and the Behaviour of Commercial Banks in India: An Analytical and Empirical Study. (DRG Study No. 22), RBI.
- Rime, B. (2001). Capital requirements and bank behaviour: Empirical evidence for Switzerland. *Journal of Banking and Finance*, 25, 789–805. doi:10.1016/S0378-4266(00)00105-9
- Saunders, A., & Wilson, B. (2001). An analysis of bank charter value and its risk-constraining incentives. *Journal of Financial Services Research*, 19, 185–195. doi:10.1023/A:1011163522271
- Shrieves, E. R., & Dahl, D. (1992). The relationship between risk and capital in commercial banks. *Journal of Banking and Finance*, 16, 439–457. doi:10.1016/0378-4266(92)90024-T
- Shukla, S. (2014). An analysis of banking system performance of select global economies with that of India: During and after the global financial. *Procedia Economics and Finance*, 11, 383–395. doi:10.1016/S2212-5671(14)00206-8
- Stolz, S., & Wedow, M. (2005). Banks regulatory capital buffer and the business cycle: Evidence for German savings and cooperative banks. Retrieved from https://www.bundesbank.de/Redaktion/EN/Downloads/Publications/Discussion_Paper_2/2005/2005_07_26_dkp_07.pdf?__blob=publicationFile.
- Wong, P.-K., Ho, Y., & Autio, E. (2005). Entrepreneurship, innovation and economic growth: Evidence from GEM data. *Small Business Economics*, 24, 335–350. doi:10.1007/s11187-005-2000-1
- Yu, H. C. (2000). Banks capital structure and the liquid asset policy implication of Taiwan. *Pacific Economic Review*, 5, 109–114. doi:10.1111/1468-0106.00093



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