How Does the Market Power Affect Market-Based Default Risk? Evidence from Indian Banks

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Outline

1 Introduction

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1 Introduction (Motivation)

- The Indian banking sector has been experiencing declining profitability, deteriorating asset quality, low efficiency, and unstable capital adequacy.
- **Measures to revive**: Asset Quality Review (AQR, 2015), Insolvency and Bankruptcy Code (IBC) 2016, the revised Prompt Corrective Action (PCA) framework 2017, recapitalization and mergers.
- The Banking Stability Indicator does not show any significant improvements in the trend of banking stability overtime.
- Banks' exposure to already troubling Non-Banking Finance Corporations (NBFCs) and Housing Finance Corporations (HFCs) has increased.

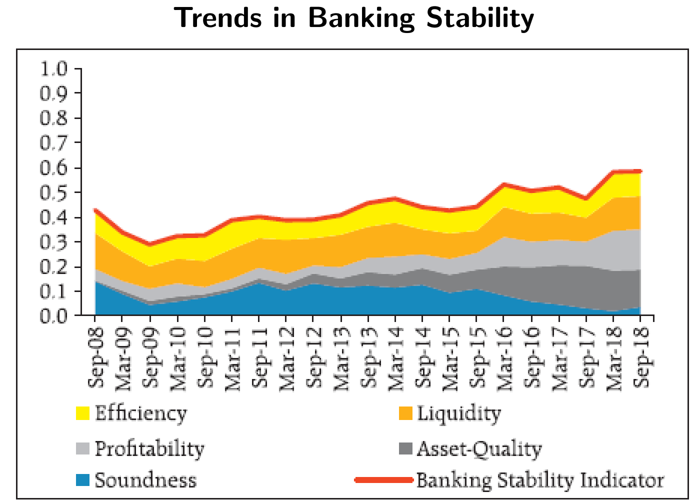

Figure: Banking Stability Indicator:Source RBI

1 Introduction (Objective)

- We aim to measure the default risk for 32 Indian Scheduled Commercial Banks (SCBs) over the period from 2005 to 2019.
- We employ the market-based risk indicator, **Distance-to-Default** (DD) measure, based on the methods developed in Black and Scholes (1973) and Merton (1974), and **Distance-to-Capital** (DC) developed by Chan-Lau and Sy (2007)
- Efficiency-based Lerner Index is used to indicate the market power.
- We further investigate the impact of market power on bank default risk along with other bank specific and macroeconomic variables by employing the Fixed effect and Generalised method of moments (GMM) methods.

1 Introduction (Findings)

- The DD and DC measures are higher for Private Banks (PVBs) as a group compared to the Public Sector Banks (PSBs). Moreover, DD and DC for the PVBs have an increasing trend, whereas DD and DC for PSBs have been substantially low.
- Strong and negative association between bank market power and banks' default risk measured by DD and DC.
- Third, among other essential determinants of DD and DC, are the GNPAs at the bank level and real GDP, and stock market volatility at the macro level.

1 Introduction (Contribution)

- First work to use DC as a measure of default risk in an empirical setup to highlight the banks' fragility in the Indian context.
- Use of DC as a default risk measure also adds to our global information about the competition-risk nexus in the banking sector.
- In the context of Indian banking sector, the use of both DD and DC as the risk measures in investigating the relationship between market power and default risk is the first work of its kind.

- **Fu et al. (2014): Market power and bank fragility**
  - Negative relationship between Lerner index and individual bank risk.
  - Positive relationship between concentration and bank risk.
- **Kabir and Worthington (2017): Market competition and bank risk**
  - Use DD, Z-score, Non-performing loans as the bank default risk measures and Lerner index as a market power indicator.
  - Support the competition–fragility hypothesis.
- **Odesanmi and Wolfe (2007): Income diversification and Bank insolvency**
  - Diversification across and within interest and non-interest income sources results in lower insolvency risk.
- **Anginer et al. (2018): Corporate governance and bank's standalone risk and systemic risk**
  - Positive association between shareholder-friendly corporate governance and bank's standalone risk and its contribution to systemic risk.

- Calculation: Distance to Default
- Calculation: Distance to Capital

- Equity (E) of a bank is assumed as a call option on the value of its assets (V). Debt (D) of the bank is assumed as the strike price (L) with a maturity time (T-t)

$$V_t = L_t + E_t \tag{1}$$

- The payoff to equity holders determined according to the following expression

$$E = Max(0, V - L) \tag{2}$$

- Taking the analogy from the Black-Scholes' option pricing theory, the equity price can be determined by the following equation

$$E_t = V_t.N(d_1) - e^{-r(T-t)}.D.N(d_2) \tag{3}$$

- where r is the risk-free rate, $N(d_1)$ and $N(d_2)$ are cumulative distribution functions of normal distribution which the bank's asset value is assumed to follow.

3. Theoretical model (Calculation: Distance to Default Cont.)

- The variables d_1 and d_2 are defined as follows

$$d_1 = \frac{ln(V_t/L_t) + (r + (1/2)\sigma_A^2)(T - t)}{\sigma_A \sqrt{(T - t)}} \tag{4}$$

$$d_2 = d_1 - \sigma(T - t) = \frac{ln(V_t/L_t) + (r - 1/2(\sigma_A^2))(T - t)}{\sigma_A \sqrt{(T - t)}} \tag{5}$$

- Where, σ_A is the bank's asset volatility and (T-t) is the time to maturity of the debt (which is assumed as 1 year in this analysis).

3. Theoretical model (Calculation: Distance to Default Cont.)

- The relation between the bank's equity volatility (σ_E) and asset volatility (σ_A) is defined by the below mentioned Ito's lemma

$$\sigma_E = (V/E)(\delta E/\delta V)\sigma_A \tag{6}$$

- From equation 3

$$(\delta E/\delta V) = N(d_1) \tag{7}$$

- Therefore,

$$\sigma_E = (V/E)N(d_1)\sigma_A \tag{8}$$

3. Theoretical model (Calculation: Distance to Default Cont)

- Bank's asset value V, its volatility σ_A are not observable and can be calculated by solving the nonlinear equations 3 and 8.
- The DD and Probability of default are then calculated using the following expressions respectively

$$DD = \frac{ln(V_t/L_t) + (r - 1/2(\sigma_A^2))(T - t)}{\sigma_A\sqrt{(T - t)}} \tag{9}$$

$$Prob.(Default) = N(-DD) \tag{10}$$

3. Theoretical model (Calculation: Distance to Default Cont.)

- We also calculate the DD following the Z-score formula defined by Liu et al. (2006) which is based on the stochastic interest rate.

- They develop their measure (DD(Z) from here) by taking into account the interest risk as follows

$$DD(Z) = (V_t - L_t)/(\sigma_A V_t) \tag{11}$$

- Chan-Lau and Sy (2007) presume a default barrier based on PCA norms and define the distance measure with new default barrier as follows

$$DD = \frac{ln(V_t/\gamma D_t) + (r - 1/2(\sigma_A^2))(T - t)}{\sigma_A \sqrt{(T - t)}} \quad (12)$$

- Where D is the usual default barrier of the bank as defined in Merton's model (sum of short-term debt and half of the long-term debt), and is an adjustment factor to incorporate the capital adequacy ratio thresholds under the PCA framework.

3. Theoretical model (Calculation: Distance to Capital Cont.)

- The adjustment factor can be defined as follows

$$\gamma = \frac{1}{(1 - CAR)} \tag{13}$$

- Likewise, the DC measure following the method of Liu et al. (2006), denoted as DC(Z) can be developed as follows

$$DC(Z) = (V_t - \gamma D_t)/(\sigma_A V_t) \tag{14}$$

- Variable Description
- Empirical Methodology

4. Data and Methodology (Variable Description)

Table 1: Variable Description and Data Sources

Variable	Description	Source
Distance to Default and Distance to capital	The expected difference between the asset value of the bank and the default barrier, after correcting and normalizing for the volatility of assets.	Authors own calculation.Thomson Reuters Datastream for market components of DD (such as price index, outstanding shares, short- and long-term debt components) and CEIC database for 3 months treasury bills rate.
Lerner index	Ratio of mark-up (difference between price and marginal cost) to price	Author's own calculation as shown in appendix A1 (RBI database is the source of its components)
Capital Adequacy Ratio	Ratio of total capital (Tier 1 and Tier 2 capital) to risk weighted assets	RBI database
GNPAs	Ratio of gross non-performing advances to total advances	RBI database
Size	Natural log of bank's assets	RBI database
Interest rate	the cyclical component of the Mumbai Inter Bank Offered Rate (MIBOR)	CEIC database
Volatility	Calculated as GARCH (1 1) of the log return of S&P BSE 500 price index	BSE official website
Growth_gdp	Annual growth of real Gross Domestic Product (GDP)	Handbook of Statistics on the Indian Economy, RBI database
Inflation	Annual rate of change in Wholesale Price Index (WPI)	Handbook of Statistics on the Indian Economy, RBI database

- **Static model**:
  - We define the econometric model as follows:

$$DD_{it} = \alpha_i + \beta LI_{it} + \gamma Bank_{it} + \delta Macro_t + \epsilon_{it} \tag{15}$$

  - We estimate equation 15 using the simple fixed effect model with the standard error defined in Driscoll-Kraay (1998).
- **Dynamic Model**:
  - we estimate the following dynamic Generalised Method of Moment (GMM) model

$$DD_{it} = \alpha_i + \beta \sum_{j=1}^{k} D_{i,t-j} + \gamma \sum_{j=0}^{k} X_{i,t-j} + \delta Macro_t + \epsilon_{it} \tag{16}$$

- Preliminary results
- Regression results
- Robustness

Table 2: Descriptive Statistics

Variable	Observation	Mean	Std.Dev.	Minimum	Maximum
dd	480	8.134	5.64	1.458	48.319
dc	480	7.818	5.628	0.985	47.678
Lerner	480	7.173	4.885	0.813	23.676
size	480	11.463	1.363	7.153	15.119
car	480	13.123	2.244	2.000	22.46
gnpa	480	4.624	4.693	0.000	27.954
mibor_hp	480	0.0000	1.395	-2.484	1.989
gdp	480	6.995	1.438	3.087	8.498
vol	480	2.168	1.912	0.722	7.217
Inf	480	4.777	3.286	-3.652	9.562

Table 3: Pairwise Correlation

Variables	dd	dc	Lerner	size	car	gnpa	mibor_hp	gdp	vol	inf
dd	1.000									
dc	0.787*	1.000								
Lerner	0.465*	0.629*	1.000							
size	0.200*	-0.020	-0.066	1.000						
car	0.329*	0.419*	0.488*	0.052	1.000					
gnpa	-0.157*	-0.287*	-0.200*	0.215*	-0.415*	1.000				
mibor_hp	-0.053	-0.053	-0.071	0.050	-0.015	-0.245*	1.000			
gdp	0.096*	0.076	0.021	-0.069	-0.102*	0.096*	0.138*	1.000		
vol	-0.338*	-0.137*	0.018	-0.138*	-0.063	-0.005	0.228*	0.038	1.000	
inf	-0.166*	-0.035	-0.119*	-0.211*	0.154*	-0.332*	0.280*	-0.399*	0.116*	1.000

5. Results and Discussion (Regression Results)

Table 4: Results with FIXED EFFECT and SYSTEM GMM estimators

VARIABLES	**Model 1** **dd**	**Model 2** **dc**	**Model 3** **dd**	**Model 4** **dc**	**Model 5** **dd**	**Model 6** **dc**
L.dd					0.396***	
					(0.091)	
L.dc						0.403***
						(0.095)
Lerner	0.637***	0.632***			0.422**	0.446**
	(0.206)	(0.206)			(0.201)	(0.207)
size	0.680***	0.619***			0.14	0.203
	(0.185)	(0.190)			(0.377)	(0.368)
car	0.380***	0.384***			0.0112	-0.0293
	(0.109)	(0.108)			(0.182)	(0.170)
gnpa	-0.180***	-0.178***			-0.129**	-0.157**
	(0.058)	(0.060)			(0.062)	(0.068)
L.Lerner			0.578**	0.574**		
			(0.227)	(0.224)		
L.size			0.665**	0.599**		
			(-0.242)	(0.242)		
L.car			0.506***	0.503***		
			(0.080)	(0.081)		
L.gnpa			-0.118*	-0.115		
			(0.064)	(0.065)		
mibor_hp	-0.295***	-0.299***	-0.348***	-0.355***	-0.488***	-0.518***
	(0.068)	(0.066)	(0.081)	(0.082)	(0.134)	(0.121)
gdp	0.607***	0.601***	0.568***	0.563***	0.406***	0.425***
	(0.141)	(0.138)	(0.141)	(0.139)	(0.062)	(0.063)
vol	-0.358***	-0.340***	-0.284***	-0.269***	-0.373***	-0.363***
	(0.082)	(0.078)	(0.077)	(0.073)	(0.125)	(0.109)
inf	0.141**	0.145**	0.143**	0.148**	0.132***	0.144***
	(0.057)	(0.055)	(0.057)	(0.055)	(0.042)	(0.039)
	(3.357)	(3.361)	(3.938)	(3.936)	(3.928)	(3.851)
AR(1)/AR(2)	-	-	-	-	**0.039/0.060**	**0.041/0.057**
Hansen J	-	-	-	-	**0.479**	**0.525**
R square	0.2625	0.2575	0.2333	0.2258		

5. Results and Discussion (Regression Results Cont.)

- Ceteris-paribus, more market power in the hand of a bank leads to a reduction in the default risk of that bank.
- Adequate capitalization and large size also contribute to bank's health and its distance from default.
- Negative and significant association with the GNPAs also intuitive and supported by earlier findings.
- Among macro level indicators, GDP growth and Stock market Volatility are the important determinants of bank default risk.

5. Results and Discussion (Robustness)

Table 5: Results with FIXED EFFECT and SYSTEM GMM estimators using DD(Z) and DC(Z)

VARIABLES	Model 1 dd_z	Model 2 dc_z	Model 3 dd_z	Model 4 dc_z	Model 5 dd_z	Model 6 dc_z
L.dd					0.186** (0.0856)	
L.dc						0.193* (0.105)
Lerner	0.119** (0.0454)	0.125** (0.0467)			0.0708** (0.0293)	0.0761*** (0.0274)
size	0.333*** (0.0539)	0.302*** (0.0445)			0.177** (0.0736)	0.158** (0.0683)
car	0.0361** (0.0164)	0.0439** (0.0164)			0.0178 (0.0451)	0.0267 (0.0431)
gnpa	-0.0311*** (0.00887)	-0.0320** (0.0114)			-0.0156 (0.0138)	-0.0167 (0.0135)
L.Lerner			0.0883 (0.0602)	0.0932 (0.0601)		
L.size			0.363*** (0.0741)	0.331*** (0.0641)		
L.car			0.0795*** (0.0188)	0.0832*** (0.0192)		
L.gnpa			-0.0190 (0.0118)	-0.0183 (0.0134)		
mibor_hp	-0.0357 (0.0261)	-0.0431* (0.0228)	-0.0310 (0.0244)	-0.0411* (0.0216)	-0.0376 (0.0400)	-0.0436 (0.0407)
gdp	0.117*** (0.0383)	0.122*** (0.0377)	0.106** (0.0363)	0.112*** (0.0354)	0.0780*** (0.0204)	0.0826*** (0.0199)
vol	-0.124*** (0.0296)	-0.117*** (0.0271)	-0.102*** (0.0301)	-0.0966*** (0.0264)	-0.124*** (0.0203)	-0.120*** (0.0215)
inf	0.0212 (0.0140)	0.0270* (0.0130)	0.0173 (0.0147)	0.0238* (0.0132)	0.0141 (0.0138)	0.0204* (0.0112)
AR(1)/AR(2)	-	-	-	-	**0.002/0.178**	**0.002/0.132**
Hansen J	-	-	-	-	**0.666**	**0.639**
R square	0.3957	0.3689	0.3949	0.3606	-	-

Table 6: Results using SYSTEM GMM estimator with a quadratic form

VARIABLES	**Model 1** **dd**	**Model 2** **dc**
L.dd	0.414***	
	(0.106)	
L.dc		0.428***
		(0.111)
Lerner	0.649	0.717
	(0.454)	(0.446)
Lerner_sq	-0.0122	-0.0150
	(0.0236)	(0.0228)
car	-0.0222	-0.0560
	(0.199)	(0.175)
gnpa	-0.128*	-0.159**
	(0.0693)	(0.0704)
size	0.192	0.261
	(0.417)	(0.391)
mibor_hp	-0.524***	-0.562***
	(0.170)	(0.165)
vol	-0.359***	-0.343***
	(0.125)	(0.111)
gdp	0.416***	0.438***
	(0.0784)	(0.0761)
inf	0.143**	0.158***
	(0.0561)	(0.0514)
Observations	448	448
AR(1)/AR(2)	**0.039/0.058**	**0.040/0.054**
Hansen J	**0.429**	**0.481**
Bank FE	Yes	Yes
Year FE	No	No

Table 7: Results using Quantile model

VARIABLES	Model 1 dd	Model 2 dd	Model 3 dd	Model 4 dd	Model 5 dd
Lerner	0.556	0.585**	0.637***	0.680**	0.734*
	(0.345)	(0.267)	(0.209)	(0.281)	(0.445)
size	0.384	0.489	0.678**	0.836*	1.035
	(0.537)	(0.415)	(0.326)	(0.438)	(0.693)
car	0.385**	0.383***	0.380***	0.377***	0.374*
	(0.151)	(0.117)	(0.0914)	(0.123)	(0.195)
gnpa	-0.220***	-0.206***	-0.181***	-0.160***	-0.133*
	(0.0581)	(0.0449)	(0.0352)	(0.0473)	(0.0749)
mibor_hp	-0.244	-0.262	-0.295**	-0.323*	-0.357
	(0.211)	(0.163)	(0.128)	(0.172)	(0.272)
gdp	0.490***	0.531***	0.606***	0.669***	0.748***
	(0.187)	(0.145)	(0.114)	(0.152)	(0.241)
vol	-0.449***	-0.417***	-0.359***	-0.310***	-0.249
	(0.139)	(0.107)	(0.0843)	(0.113)	(0.179)
inf	0.0733	0.0974	0.141**	0.177**	0.222*
	(0.0966)	(0.0746)	(0.0587)	(0.0787)	(0.125)
Observations	480	480	480	480	480
Bank FE	Yes	Yes	Yes	Yes	Yes
Quantile	**10th**	**25th**	**50th**	**75th**	**90th**

Table 8: Results using Quantile model

VARIABLES	Model 1 dc	Model 2 dc	Model 3 dc	Model 4 dc	Model 5 dc
Lerner	0.556	0.583**	0.631***	0.672**	0.721*
	(0.341)	(0.262)	(0.206)	(0.280)	(0.438)
size	0.306	0.418	0.618*	0.787*	0.990
	(0.529)	(0.407)	(0.320)	(0.434)	(0.679)
car	0.390***	0.388***	0.384***	0.381***	0.377**
	(0.150)	(0.115)	(0.0902)	(0.123)	(0.192)
gnpa	-0.219***	-0.204***	-0.179***	-0.157***	-0.131*
	(0.0582)	(0.0447)	(0.0351)	(0.0477)	(0.0747)
mibor_hp	-0.246	-0.265*	-0.299**	-0.328*	-0.362
	(0.209)	(0.161)	(0.126)	(0.172)	(0.268)
gdp	0.490***	0.530***	0.600***	0.661***	0.732***
	(0.185)	(0.142)	(0.112)	(0.152)	(0.238)
vol	-0.436***	-0.402***	-0.340***	-0.288**	-0.226
	(0.138)	(0.106)	(0.0833)	(0.113)	(0.177)
inf	0.0774	0.101	0.144**	0.181**	0.224*
	(0.0956)	(0.0734)	(0.0578)	(0.0784)	(0.123)
Observations	480	480	480	480	480
Bank FE	Yes	Yes	Yes	Yes	Yes
Quantile	**10th**	**25th**	**50th**	**75th**	**90th**

6. Conclusion and Policy Implication

- Besides the market power, GNPAs, real GDP, and stock market volatility are found consistent and significant determinants of bank default risk across all models employed under the robustness analysis.

- Under the current uncertain macroeconomic conditions and geo-political developments, market-based measures should be utilized along with accounting measures to assess an individual bank's credit and default risk

- Considering the Measures taken in the revised PCA, DC should be utilised for banking stability analysis especially of the systemic nature.

- Banks should be strengthened to have more market power. Along these lines, there is also a consolidation process going on in the Indian banking market.

- Caveat
    - Moral Hazard: Induced through the assurance the regulators' bail-out at the time of crisis.
    - Hidden political connection may also encourage the banks provide a huge amount of loans to big corporate houses and other major players.
    - The consolidation process should be accompanied by providing opportunities to the banks to increase their non-interest income.
    - Non-interest income sources: Service charges on the maintenance of deposit accounts, and income from participation in financial instruments relating to commodities, foreign exchange, and stock bonds.

7. References

- Anginer, D., Demirguc-Kunt, A., Huizinga, H., Ma, K. (2018). Corporate governance of banks and financial stability. Journal of Financial Economics, 130(2), 327-346.
- Black, F., Scholes, M. (1973). The pricing of options and corporate liabilities. Journal of political economy, 81(3), 637-654.
- Byström, H. N. (2004). The market's view on the probability of banking sector failure: cross-country comparisons. Journal of International Financial Markets, Institutions and Money, 14(5), 419-438.
- Chan-Lau, J. A., Sy, A. N. (2007). Distance-to-default in banking: a bridge too far?. Journal of Banking Regulation, 9(1), 14-24.
- De Souza, S. R. S., Silva, T. C., Tabak, B. M., Guerra, S. M. (2016). Evaluating systemic risk using bank default probabilities in financial networks. Journal of Economic Dynamics and Control, 66, 54-75.
- Fu, X. M., Lin, Y. R., Molyneux, P. (2014). Bank competition and financial stability in Asia Pacific. Journal of Banking Finance, 38, 64-77.

7. References Cont.

- Kabir, M. N., Worthington, A. C. (2017). The 'competition–stability/ fragility' nexus: A comparative analysis of Islamic and conventional banks. International Review of Financial Analysis, 50, 111-128.
- Merton, R. C. (1974). On the pricing of corporate debt: The risk structure of interest rates. The Journal of finance, 29(2), 449-470.
- Milne, A. (2014). Distance to default and the financial crisis. Journal of Financial Stability, 12, 26-36.
- Saldías, M. (2013). Systemic risk analysis using forward-looking distance-to-default series. Journal of Financial Stability, 9(4), 498-517.
- Schenck, N. A. (2014). Distance-to-default measures and determinants for systemically important financial institutions. Journal of Financial Regulation and Compliance.
- Wu, J., Guo, M., Chen, M., Jeon, B. N. (2019). Market power and risk-taking of banks: Some semiparametric evidence from emerging economies. Emerging Markets Review, 41, 100630.

Thank You