Systemic Risk in Indian Banking: Measurement and Impact of COVID-19

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ABSTRACT

This study examines the systemic risk in the Indian banking system using two models. The systemic risk cube explains the importance of measuring systemic risk in a scenario like contagion and systemic risk measurement index SRISK as proposed by NYU stern. Measurement of SRISK is done for two time-periods: before COVID-19 i.e. February 2020 and after COVID-19 i.e. February 2021. The findings show that the COVID-19 pandemic has not shown increase in SRISK considerably unlike 2009 crisis when the SRISK increased considerably, causing an economic downturn. The banking system remains a vital part for economic stability and studying the financial system to scale its impact on the economy during extreme events like in a pandemic remains an unflinching necessity of the time.

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1. Introduction

Systemic risks are the non-conventional risks associated with the collapse or failure of a system. Systemic implies within the boundaries of a system, which is a complex one comprised of interrelated procedures and mechanisms working together. As per the above definition, the system under consideration in this paper is the financial banking system. Hence systemic risk results in a domino effect eventually leading to an economic slump due to collapse of the financial system.

In this paper, we look at the systemically important banks (SIBs), the failure of which would cause the economy and entire financial system to collapse due to their inter-connected businesses and intermediaries. This cascading effect can spread across the whole financial system, in turn causing the economy to collapse. The strong interconnect between elements makes defining the systemic risks hard and measuring the impact harder.

The past financial crisis of the US in 2008-09 and European crises in 2010-11 have proved that it is paramount to take note of factors in the systemic risk to financial institutions arising from other parts of the world. Initially the Indian banking system was relatively unaffected by the crises mentioned above, but it was indirectly affected due to the presence of foreign banks in India. This has proved that monitoring of systemic risk is essential to avoid potential system failure.

The COVID-19 pandemic in 2020 is yet another existing example of triggering a systemic risk that might cause the economy to collapse. It is important to note that in India, the government has rolled out fiscal packages to boost economic growth and help the borrowers to pay their debt. However, it is also vital to consider the stress it puts on the banks and whether the banks will withstand this strain.

The Indian banking system includes both public sector banks and banks in the private sector. Public sector banks are owned and controlled by the government and are subjected to political interference and constraints. At the same time, private sector banks are said to be more stable because the shares are not owned by Government and therefore better managed without political interference. This paper measures the systemic risks in both the public and private sector banks pre and post COVID-19 contagion.

Reserve Bank of India (RBI) conducts a systemic risk survey (SRS) to capture experts' perceptions, including market participants, on the significant risks faced by the financial system. SIBs are perceived as banks that are 'Too Big to Fail'. This gives rise to an expectation of government to support these banks in times of distress. Due to which the banks enjoy an undue advantage in the funding markets. However, this support increases the risk-taking behavior and reduces discipline thus increasing the probability of distress in the future. Hence to avoid such slippages and reduce the moral hazard posed by them, the SIBs are subjected to various additional policy measures.

According to the Basel III norms, a framework was created to deal with the Domestically Systemically Important Banks (D-SIBs). In a D-SIB framework, the national authorities carry out an

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assessment to assess the effect on the local economy and banks and thereby take action to restrict the negative impact emanating from systemic forces outside and provide necessary stimulus. RBI releases a list of these D-SIBs based on the data collected from the banks and notifies in the press release the systemically important banks. A comparison of the research of systemically important banks pre-COVID and post-COVID is made with RBIs list later in this paper. This will help us draw further insights into the current situation of the economy.

2. Literature Review

Many approaches are proposed for measuring systemic risk in the literature (Adrian and Brunnermeier, 2008; Acharya et al., 2010a, 2010b; Acharya and Steffan, 2012; Moore and Zhou, 2014; Van Oordt and Zhou, 2015). The measurement of systemic risk can expose the vulnerability of a system to cause a failure. There is extensive ongoing research and debate to find an unrivalled systemic risk measure. We have used two popular models to understand it.

The systemic risk cube was first introduced in the 2009 Financial Stability Review Report by the European Central Bank. The cube helps to visualize the systemic risk conceptually. It has three axes viz, triggers, origins, and impacts. Triggers are the starting point of the crisis which could be exogenous shocks or endogenous. Exogenous shocks are the events outside the system under consideration and endogenous are the shocks which are within the system. Financial crisis of 2009 was an endogenous shock caused due to the collapse of banking system. The second axis of origin indicates that the trigger can be limited and distinguished or widespread and systemic. The third and final axis of impact indicated the influence of the shock will either affect a single portion of the system or will affect the entire system.

Another measure is the SRISK index as proposed by Brownlees and Engle (2012, 2017) and Acharya et al. (2012) as an estimate of the expected capital shortage of a bank during a market meltdown. Hattori et al. (2014) cited that certain types of trigger events based on past patterns of failure are used for measuring systemic risk which is indirectly a form of scenario analysis. He however raised concerns that this may not be a robust indicator against future failures which are unprecedented. Also, they argued that most market-based estimates of systemic risk might overestimate the importance of short-term changes. It was suggested that for a broader range of failure sources, the macro stress testing scenarios needed to be merged with different risk measures.

In the case of contagion like COVID-19, the RBI Governor Shantikanta Das has cited that 'once in a lifetime' economic events are becoming 'once in a decade' events. Using the standard VaR and CoVaR does not effectively measure these extreme tail events that happen once or twice a decade.

V Acharya, Pederson, Phillipon and Richardson (2010) have used extreme value theory and define Marginal Expected Shortfall (MES) where they link an extreme tail event and moderately bad event. When the equity value in comparison to its debts reduces to a very small fraction in a financial firm, the entity cannot function while in a normal situation there is a likelihood of acquisition or even raise fresh capital. The problem could be compounded when the firm is also facing systemic financial constraints. Government of that country is faced with a dilemma to bail out the bank with taxpayers' money if there is no other option, otherwise a capital shortage of the financial entity will affect the economy as a whole.

Verma et.al (2019) use Tail-Event-Driven Networks (TENET) risk model and observe that SBI and HDFC are Domestic Systemically Important Banks along with a few other banks. Their findings reveal that Government owned banks are more vulnerable as compared to private owned banks. Six factors cause it, viz. banking panics – when depositors withdraw more money than they need for consumption; banking crises - due to falling asset prices; contagion; financial architecture; foreign exchange mismatches in the banking system and due to uncharted waters - such as the referendum on the 'Brexit' (Allen, Goldstein and Jagtiani 2018)

3. Research Methodology

The objective is to measure the systemic risks and gauge the impact of COVID-19 by observing the change in the systemic risk measured. For this study, 32 publicly traded Indian Banks are taken into consideration, including 12 public sector and 20 private sector banks. The data for analysis was collected from NSE, yahoo finance and money control. Calculation of beta used in LRMES for both the periods was manually calculated using daily stock returns for one-year tenure in each case. The market capitalization calculated is as of February 29 2020, for pre-COVID analysis and February 28 2021, for post-COVID analysis. In order to get the debt values of the banks for 2021, forecasting was done based on the average year on year growth of the past five years.

The calculation of systemic risk is in two steps. First is estimating the fractional loss in equity while in a crisis. The crisis under this pretext looks for a considerable aggregate market decline over a six-month period. This is called Long-Run Marginal Expected Shortfall or LRMES. LRMES is calculated using the below formula:

$$\text{LRMES} = 1 - \exp(\log(1-d) \cdot \beta)$$

Equation 1

where d is the crisis threshold for the market index decline, and β is the responsiveness of a stock's price to changes in the overall stock market. For calculations, the crisis threshold is taken as 40% for this study which is also the default value considered.

This measure is the mean of the returns of equity in the crisis scenario. The measure contains the volatility of the firm and its correlation with the market, as well as its performance in extremes. The list of banks under consideration in the study are mentioned in Table 1 below.

Table 1. List of Banks

Public Sector	Private Sector
PNB	ICICI Bank
Bank of Baroda	Kotak Mahindra
Canara Bank	Axis Bank
Union Bank	IndusInd Bank
Bank of India	Bandhan Bank
IOB	Yes Bank
Indian Bank	AU Small Finance
UCO Bank	IDBI Bank
Bank of Maharashtra	IDFC First Bank
Central Bank	Federal Bank
Punjab & Sind	RBL Bank
	City Union Bank
	Equitas Bank
	Karur Vysya
	DCB Bank
	JK Bank
	Karnataka Bank
	South Ind Bk
	Dhanlaxmi Bank

Secondly, the current equity market value is combined with the shortfall calculated during the crisis and subtracted from the outstanding debt of the firm to calculate the capital required during a crisis. The method describes it as SRISK (Systemic Risk); symbolically, it can be defined as

$$\text{SRISK}_{i,t} = E_{t-1} (\text{Capital Shortfall}_i | \text{Crisis})$$

Equation 2

When the capital shortfall is very high, these firms end up winding up their business and also precipitate more to the crisis. Capital shortfall (SRISK) is computed as

$$\text{SRISK} = k \times \text{DEBT} - (1-k) \times \text{EQUITY} \times (1 - \text{LRMES})$$

Equation 3

where k is the capital requirement, DEBT is the book value of debt calculated as book value of assets less book value of equity, EQUITY is the current market capitalization of this firm and LRMES is the long run marginal expected shortfall.

4. Findings

To gauge the impact of COVID-19 by measuring SRISK for both public sector and private sector banks, the data was analyzed for two time periods. Before COVID-19 impact of February 2020 and post COVID-19 impact for February 2021. The calculated SRISK is shown below in Table 2 for public sector banks and Table 3 for private sector banks.

Table 2. SRISK values for public sector banks

Name	Post COVID	Pre COVID
	SRISK21	SRISK 20
SBI	1,43,607.34	1,87,877.85
PNB	40,725.98	50,401.64
Bank of Baroda	86,586.73	75,913.31
Canara Bank	49,324.40	54,203.86

Name	Post COVID	Pre COVID
	SRISK21	SRISK 20
Union Bank	34,123.52	39,367.65
Bank of India	41,034.66	45,706.35
IOB	6,661.64	11,083.23
Indian Bank	18,690.79	22,902.46
UCO Bank	8,515.78	10,584.61
Bank of Maharashtra	6,219.80	9,940.69
Central Bank	24,563.56	23,856.66
Punjab & Sind	7,775.60	7,782.69

Table 3. SRISK values for Private sector banks

Name	Post-COVID	Pre COVID
	SRISK21	SRISK20
HDFC Bank	-4,68,985.85	-3,42,936.79
ICICI Bank	-1,79,829.55	-1,15,947.39
Kotak Mahindra	-2,40,031.58	-1,98,097.85
Axis Bank	-56,616.70	-59,073.82
IndusInd Bank	-18,391.44	-23,848.77
Bandhan Bank	-24,328.69	-35,395.07
Yes Bank	-14,322.42	-4,338.89
AU Small Finance	-19,448.01	-24,804.31
IDBI Bank	-1,120.11	-2,882.99
IDFC First Bank	-6,372.31	-11.52
Federal Bank	7,064.71	3,924.26
RBL Bank	-1,257.20	-1,411.70
City Union Bank	-4,321.51	-8,724.06
Equitas Bank	-1,820.33	-5,693.22
Karur Vysya	2,448.80	3,102.12
DCB Bank	1,228.12	553.12
JK Bank	8,420.01	8,184.82
Karnataka Bank	6,144.08	5,606.50
South Ind Bk	8,056.70	7,056.60
Dhanlaxmi Bank	754.04	760.00

The public sector banks have a positive SRISK, while private sector banks have a negative SRISK barring few banks as can be observed from Table 3 above. It can be observed that there is not a vast difference in the systemic risks post-COVID even though the debt of the banks is expected to increase. This is due to a massive boost in the Indian Equity markets, increasing the market capitalization of the bank.

Figure 1. SRISK pre and post COVID of Public Sector Banks

Figure 2. SRISK pre and post COVID of Private Sector Banks

4.1 Comparison with NYU stern VLAB

From the below image from VLAB, we can see that the systemic risk for the Indian Banking system as computed by NYU is decreasing post-COVID-19 in February 2021. This can also be observed in Figure 2, where the public sector banks SRISK has reduced post-COVID-19. The private sector banks, however, seem to have an increased SRISK if the absolute values are taken into consideration.

Figure 3. SRISK% measure for Feb 2020 by NYU VLAB

Figure 4. SRISK% measure for Feb 2021 by NYU VLAB

4.2 Comparison with RBI Systemic Risk Survey (SRS) report of January 2021:

The systemically important banks in the public sector are SBI, Bank of Baroda, Canara Bank, shown in Figure 2. For private sector banks, figure 3 shows that HDFC Bank, Kotak Mahindra and ICICI Bank are

systemically significant. Hence these banks are too big to fail, but if they fail, it can lead to an economic downturn. As stated earlier, the RBI conducts SRS survey and releases a list of banks which are systemically important for the Indian economy.

From the calculated SRISK values, for the private banks, apart from HDFC bank and ICICI bank; Kotak Mahindra bank should also be considered as a D-SIB. The value for SRISK signifies that organizations with huge capital shortfall are not only the biggest losers during a crisis but also pose a higher risk to the system. This makes Kotak Mahindra an important consideration for the list of banks which are too big to fail for the economy and poses a threat for systemic failure.

5. Conclusion

The study contributes to the literature by analyzing the impact of an ongoing contagion of COVID-19 on the Indian banking system. Earlier studies and the literature consist of the need for analyzing systemic risk due to the financial crisis of 2009. However, we can now observe the systemic risk associated with the financial systems when a pandemic occurs. These are extreme events, and a comparative study of both endogenous (Financial crisis of 2009) and exogenous (COVID-19) events show that it does not have a similar impact on the riskiness of the financial institutions. While on the one hand, in 2009, the SRISK increased considerably, causing an economic downturn, the COVID-19 pandemic has not shown a similar alert.

It can be concluded that the impact of COVID-19 has been minimized on the systemic risk of the Indian Banking sector due to the equal boost in the Indian equity markets leading to an increase in the market capitalization of the banks. As a part of RBI SRS, it is our suggestion to include Kotak Mahindra bank apart from the existing SBI, HDFC Bank and ICICI bank as a systemically important bank (SIBs).

Reserve Bank of India Governor has urged banks to augment their stress testing framework with various scenarios and watch out for any early warning signals and take corrective action on their own proactively, particularly the SIB banks where their strength lies in building their capital base and also create sufficient provisions in the event of any defaults. RBI at the apex will provide liquidity in the system and maintain flow of credit in the economy

The study can further be extended to non-banking financial institutions to understand its impact on the Indian economy. Also, there is a constant debate on the 'fat-tail normal distribution' assumption of economic events, i.e. economic events follow a bell-shaped or normal distribution. This study can be extended to a non-normal distribution expected to simulate a stress scenario close to what is being played out during the COVID crisis.

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Appendix A

SRISK calculation of Public Sector Banks

Feb 2021 Public Sector				
Company Name	Market Cap (Rs. Cr.)	Debt	LRMES	SRISK
SBI	349889.4	4306530.54	0.23373	1,43,607.34
PNB	41334.46	807959.89	0.14952	40,725.98
Bank of Baroda	36756.61	1259120.44	0.20074	86,586.73
Canara Bank	26446.62	750693.24	0.24218	49,324.40
Union Bank	21559.03	563313.84	0.15516	34,123.52
Bank of India	19923.69	627271.26	0.14952	41,034.66
IOB	18672.42	241501.64	0.11290	6,661.64
Indian Bank	13857.33	319911.10	0.19896	18,690.79
UCO Bank	12883.92	213300.72	0.08897	8,515.78
Bank of Maharashtra	10109.2	159783.96	0.11290	6,219.80
Central Bank	8419.68	349291.64	0.10301	24,563.56
Punjab & Sind	997.6	95012.45	0.14573	7,775.60

Feb 2020 Public Sector				
Company Name	Market Cap (Rs. Cr.)	Debt	LRMES	SRISK
SBI	270415.7295	3946432.22	0.32013	1,87,877.85
PNB	30352.7341	768308.43	0.32131	50,401.64
Bank of Baroda	35254.92444	1086059.30	0.31949	75,913.31
Canara Bank	14804.45294	700234.32	0.34552	54,203.86
Union Bank	12715.7729	521519.66	0.34587	39,367.65
Bank of India	16728.69337	617945.70	0.34910	45,706.35
IOB	14300.17984	244571.85	0.16022	11,083.23
Indian Bank	4508.168478	287373.38	0.27820	22,902.46
UCO Bank	12249.15067	216698.52	0.19992	10,584.61
Bank of Maharashtra	6086.194219	158108.35	0.22558	9,940.69
Central Bank	8907.229849	335800.94	0.21469	23,856.66
Punjab & Sind	1069.105971	94907.41	0.21987	7,782.69

Appendix B

SRISK calculation of Private Sector Banks

Feb 2021 Pvt Sector				
Company Name	Market Cap (Rs. Cr.)	Debt (Rs. Cr.)	LRMES	SRISK
HDFC Bank	872380.74	1699753.337	0.216539	-4,68,985.85
ICICI Bank	436892.02	1197147.812	0.276677	-1,79,829.55
Kotak Mahindra	387015.98	398793.076	0.216539	-2,40,031.58
Axis Bank	224927.67	969191.1259	0.29724	-56,616.70

IndusInd Bank	77410.76	333638.6916	0.312659	-18,391.44
Bandhan Bank	53362.82	113090.1916	0.289401	-24,328.69
Yes Bank	41090.05	275177.2414	-0.04537	-14,322.42
AU Small Finance	34052.68	65278.45525	0.182809	-19,448.01
IDBI Bank	31880.87	249229.3294	0.18823	-1,120.11
IDFC First Bank	28648.2	150666.8243	0.235426	-6,372.31
Federal Bank	16536.61	201059.5801	0.266984	7,064.71
RBL Bank	14531.86	95178.67742	0.257162	-1,257.20
City Union Bank	12183.62	49790.99927	0.20604	-4,321.51
Equitas Bank	5179.04	22001.14183	0.193614	-1,820.33
Karur Vysya	4344.31	64073.14421	0.160762	2,448.80
DCB Bank	3386.06	41935.8969	0.173694	1,228.12
JK Bank	2122.52	111289.0178	0.173694	8,420.01
Karnataka Bank	2015.99	85110.87564	0.173694	6,144.08
South Ind Bk	1491.21	102116.6872	0.164477	8,056.70
Dhanlaxmi Bank	346.37	11317.38438	0.160762	754.04

Feb 2020 Pvt Sector				
Company Name	Market Cap (Rs. Cr.)	Debt (Rs. Cr.)	LRMES	SRISK
HDFC Bank	645739.24	1404471.72	0.201292	-3,42,936.79
ICICI Bank	321858.25	1108845.92	0.2634	-1,15,947.39
Kotak Mahindra	309979.16	344526.92	0.187803	-1,98,097.85
Axis Bank	196755.60	841531.39	0.247063	-59,073.82
IndusInd Bank	76569.82	272480.57	0.305783	-23,848.77
Bandhan Bank	61753.00	76522.34	0.247586	-35,395.07
Yes Bank	43424.63	236137.2	0.35239	-4,338.89
AU Small Finance	35366.50	37766.2599	0.123673	-24,804.31
IDBI Bank	31764.62	265877.61	0.271911	2,882.99
IDFC First Bank	17700.44	133755.03	0.25193	-11.52
Federal Bank	17116.99	168530.97	0.278172	3,924.26
RBL Bank	14668.87	78418.53	0.365527	-1,411.70
City Union Bank	15810.93	44437.46	0.115688	-8,724.06
Equitas Bank	10808.23	16570.4	0.269527	-5,693.22
Karur Vysya	3341.16	61677.9	0.194563	3,102.12
DCB Bank	5022.52	35082.99	0.188143	-553.12
JK Bank	1409.07	102478.62	0.190282	8,184.82
Karnataka Bank	1966.96	77343.04	0.243338	5,606.50
South Ind Bk	1673.99	91555.55	0.223154	7,056.60
Dhanlaxmi Bank	341.57	11438.18	0.133153	760.00

Appendix C

LRMES calculations for Post-COVID

Public Bank Feb 2021		
	Beta	LRMES
SBI	1.2	0.2337
PNB	0.73	0.1495
Bank of Baroda	1.01	0.2007
Canara Bank	1.25	0.2422

Public Bank Feb 2021		
	Beta	LRMES
HDFC Bank	1.1	0.2165
ICICI Bank	1.46	0.2767
Kotak Mahindra	1.1	0.2165
Axis Bank	1.59	0.2972

Union Bank	0.76	0.1552
Bank of India	0.73	0.1495
IOB	0.54	0.1129
Indian Bank	1	0.1990
UCO Bank	0.42	0.0890
Bank of Maharashtra	0.54	0.1129
Central Bank	0.49	0.1030
Punjab & Sind	0.71	0.1457

IndusInd Bank	1.69	0.3127
Bandhan Bank	1.54	0.2894
Yes Bank	-0.2	-0.0454
AU Small Finance	0.91	0.1828
IDBI Bank	0.94	0.1882
IDFC First Bank	1.21	0.2354
Federal Bank	1.4	0.2670
RBL Bank	1.34	0.2572
City Union Bank	1.04	0.2060
Equitas Bank	0.97	0.1936
Karur Vysya	0.79	0.1608
DCB Bank	0.86	0.1737
JK Bank	0.86	0.1737
Karnataka Bank	0.86	0.1737
South Ind Bk	0.81	0.1645
Dhanlaxmi Bank	0.79	0.1608

Appendix D

LRMES calculations for Pre-COVID

Public Bank Feb 2020		
	Beta	LRMES
SBI	1.74	0.3201
PNB	1.75	0.3213
Bank of Baroda	1.74	0.3195
Canara Bank	1.91	0.3455
Union Bank	1.91	0.3459
Bank of India	1.94	0.3491
IOB	0.79	0.1602
Indian Bank	1.47	0.2782
UCO Bank	1.01	0.1999
Bank of Maharashtra	1.15	0.2256
Central Bank	1.09	0.2147
Punjab & Sind	1.12	0.2199

Private Bank Feb 2020		
	Beta	LRMES
HDFC Bank	1.01	0.2013
ICICI Bank	1.38	0.2634
Kotak Mahindra	0.94	0.1878
Axis Bank	1.28	0.2471
IndusInd Bank	1.65	0.3058
Bandhan Bank	1.28	0.2476
Yes Bank	1.96	0.3524
AU Small Finance	0.60	0.1237
IDBI Bank	1.43	0.2719
IDFC First Bank	1.31	0.2519
Federal Bank	1.47	0.2782
RBL Bank	2.05	0.3655
City Union Bank	0.55	0.1157
Equitas Bank	1.42	0.2695
Karur Vysya	0.98	0.1946
DCB Bank	0.94	0.1881
JK Bank	0.95	0.1903
Karnataka Bank	1.26	0.2433
South Ind Bk	1.14	0.2232
Dhanlaxmi Bank	0.64	0.1332