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NON-PERFORMING LOANS AND SYSTEMIC RISK OF INDIAN BANKS

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Abstract

This study examines the role of non-performing loans in systemic risk for Indian banks using a fixed-effects panel regression model, with bank fixed effects and year fixed effects. The moderator variables considered for the study include bank size, capital adequacy, leverage, deposits, loans & advances, and investments. The study introduces the concept of maximum level of non-performing loans for neutral systemic risk, which is the level of net non-performing loans to net advances for which the systemic risk is non-positive. The results of the study indicate that bank size, capital adequacy, and loans & advances have a significant impact on the maximum level of non-performing loans for neutral systemic risk. Further, the results of the study indicate major differences in the role of non-performing loans in systemic impact for public sector and private sector banks. The study suggests that the model can be used to set maximum levels of non-performing loans for individual banks with estimates or projections of the bank's characteristics.

Keywords: systemic risk, non-performing loans, neutral systemic risk, public sector banks, private sector banks

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Introduction

Systemic risk is defined as the impact that the failure of a bank or financial institution would have on the entire financial system and/or economy, through its network of inter-linked financial intermediaries. The failure of a bank or financial institution causes a financial strain on its creditor institutions, which in turn can cause failure of some of these banks or financial institutions. This results in a cascading effect, and can spread across the entire financial system. The global financial crisis of 2008-09 and subsequent Euro-zone crises of 2010-11 have highlighted the importance of monitoring the level of systemic risk of financial institutions and understanding the factors contributing to systemic risk. In particular, these crises were essentially the result of a large-scale failure of to repay loans.

Though the Indian banking system was initially relatively unaffected by the crises, it was affected indirectly, mainly through its exposure to foreign banks. This has made the monitoring of systemic risk important in order to avoid potential system failure. This study examines the role of non-performing loans in controlling systemic risk for Indian banks.

The Indian banking industry has two major segments, public sector banks and private sector banks. Public sector banks are owned and controlled by the government,

and are subjected to political interference and constraints. Many studies have suggested that private sector banks outperform public sector banks due to professional, efficient management, and better customer focus and service, particularly in terms of Management Soundness and Earnings and Profitability (Dash and Das, 2013; Dash et al., 2015). Thus, non-performing loans would be expected to play a different role in public sector and private sector banks in controlling systemic risk.

Literature Review

There are many approaches proposed for measuring systemic risk in the literature (Adrian and Brunnermeier, 2008; Acharya et al., 2010a, 2010b; Acharya and Steffan, 2013; Moore and Zhou, 2014; van Oordt and Zhou, 2019). The SRISK index was 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) pointed out that systemic risk measures are essentially a form of scenario analysis, as they analyse the impact of certain types of assumed trigger events on the financial system, based on past patterns of failure; however, this may not be an indicator for robustness against future, unprecedented modes of failure. Also, they argued that most market-based estimates of systemic risk may overestimate the importance of short-term changes. They suggested combining different systemic risk measures together with macro-stress testing scenarios, providing a wider range of potential sources of failure.

Several studies have analysed the determinants of systemic risk and systemic importance of banks (Dash, 2019; Karagozlu, 2016; Li and Zheng, 2017). A prominent determinant systemic risk is bank size/complexity. This is partially due to moral hazard; as regulators are disinclined to liquidate large and complex banks, this leads banks to take on excessive risks in the expectation of government bailouts (e.g. Farhi and Tirole, 2012). Another possible source is that of agency effects, i.e. poor governance of large and complex banks may lead to bank managers engaging in non-traditional risky activities such as trading and tend to be financed more through short-term debt, making them more vulnerable to liquidity shocks and market failures (e.g. Laeven and Levine, 2007; Boot and Ratnovski, 2016).

Empirically, many studies have found evidence of bank size as a determinant of systemic risk, in conjunction with other determinants: size and non-traditional banking activities (Moore and Zhou, 2014); bank size, interconnectedness, and Tier I capital (Bostandzic et al., 2014); banks with higher non-performing loan ratios and lower profitability ratios tended to have higher tail risk, while larger banks, with higher trading revenue, and higher non-interest income tend to have higher systemic risk (van Oordt and Zhou, 2019); systemic risk increases with bank size and is inversely related with bank capital (Laeven et al., 2016); financial leverage, size, risk, and market to book value had a significant impact on systemic risk (Anghelache and Oanea, 2016). Dash (2020) analysed the role of capital adequacy in systemic risk and proposed a model for capital adequacy targeting based on different bank characteristics.

Several studies have examined non-performing loans as a determinant of bank systemic risk. Festić et al. (2011) suggested that the rapid growth of credit in Central and Eastern European banks in recent years would harm banking performance and deteriorate non-performing loans, due to overheating of the economies, leading to higher systemic risk. Hilmarsson (2015, 2020) analysed the Nordic-Baltic Case and

Icelandic cases. Vuković and Domazet (2013) found that non-performing loans are the primary generators of systemic risk. Van Oordt and Zhou (2019) suggested that banks with higher non-performing loan ratios and lower profitability ratios tended to have higher tail risk, while larger banks, with higher trading revenue, and higher non-interest income tend to have higher systemic risk. Zhang et al. (2016) found evidence for the moral hazard hypothesis, which suggests that an increase in the proportion of non-performing loans increases riskier lending, potentially causing further deterioration of the loan quality and financial system instability. Bottazzi et al. (2016) examined the relationship between non-performing loans, systemic risk and resilience of the financial system using a network-based approach with two types of agents, banks and firms, linked together in a two-layered structure via their reciprocal claims; with which they were able to identify the maximum level of non-performing loans sustainable by the financial system.

Ouhibi et al. (2017) suggested that macroeconomic factors are significant with non-performing loans and, in turn, systemic risk. Wosser (2017) found that systemic risk was strongly related to size, maturity mismatch, non-performing loans, and non-interest-to-interest-income ratios.

Methodology

The objective of the study is to analyse the role of non-performing loans in systemic risk for banks in India. Due to the wide differences in performance between public sector and private sector banks, the determinants of systemic risk would be expected to differ between public sector and private sector banks. The present study extends the approach of Dash (2020) in the context of non-performing loans and systemic risk for banks in India.

The study was conducted using sample of thirty-two Indian banks, including twenty-two public sector banks, and ten private sector banks. The public sector banks considered in the study included Allahabad Bank, Andhra Bank, Bank of Baroda, Bank of India, Bank of Maharashtra, Canara Bank, Central Bank of India, Corporation Bank, Dena Bank, IDBI Bank, Indian Bank, Indian Overseas Bank, Punjab & Sind Bank, Punjab National Bank, State Bank of Bikaner & Jaipur, State Bank of India, State Bank of Mysore, State Bank of Travancore, Syndicate Bank, United Commercial Bank, Union Bank of India, and Vijaya Bank. The private sector banks considered in the study included Axis Bank, Federal Bank, HDFC Bank, ICICI Bank, IndusInd Bank, Jammu & Kashmir Bank, Karnataka Bank, Karur Vysya Bank, Kotak Mahindra Bank, and Yes Bank.

The data pertaining to bank characteristics was collected from the Capitaline database (www.capitaline.com). The SRISK estimates were collected from NYU Stern's V-Lab database (https://vlab.stern.nyu.edu/analysis/RISK.WORLDFIN-MR.GMES). The study period was 2007-16.

The dependent variable considered for the study is the measure of systemic risk proposed by Brownlees and Engle (2012), SRISK. This index measures the expected capital shortage faced by a bank during a period of system distress when the market declines substantially. It is estimated as:

$$SRISK_{i,t} = kD_{i,t} - (1-k)W_{i,t}(1 - LRMES_{i,t+h|t}(C_{t+h|t})),$$

where k is the minimum fraction of capital (as a ratio of total assets) each bank needs to hold, $D_{i,t}$ and $W_{i,t}$ are the book value of its debt (total liabilities) and the market value of its equity, respectively, and the long-run marginal expected shortfall LRMES is defined as the tail expectation of the firm's equity return conditional on a market decline:

$$LRMES_{i,t+h|t} = -E_t\left(R_{i,t+h|t} \middle| R_{m,t+h|t} < C\right).$$

Note that SRISK may take negative values. Banks with negative SRISK are well-capitalised banks with sufficiently large capital buffers to absorb systemic shocks easily. The total systemic risk in the financial system is measured by aggregating the positive SRISK contributions of different financial institutions.

The study focuses on the role of non-performing loans in systemic risk (van Oordt and Zhou, 2019), particularly for public sector banks. The measure for non-performing loans used for the study is the Net Non-Performing Loans to Net Advances. A bank with a larger proportion of non-performing assets would be expected to have higher systemic risk than a bank with a smaller proportion of non-performing assets. Other moderating variables considered for the study are discussed in the following.

The most common determinant for systemic risk is that of bank size, and the commonly-used proxy for size is the logarithm of the bank's total assets (see for example, Laeven et al., 2016). The systemic risk of a bank would be expected to increase with bank size. This reflects the "too big to fail" hypothesis, that the failure of a large bank would have too a great impact on the entire financial system, so that government should intervene to prevent such a failure. Consequently, the capital requirement for large banks would be expected to be larger than for small banks.

Capital adequacy is an important determinant of systemic risk (Laeven et al., 2016). The measure considered in the study is the Capital Adequacy Ratio. It is expected that higher levels of capital adequacy would be associated with a lower systemic risk.

Another important determinant of systemic risk is leverage (Anghelache and Oanea, 2016). This has also been included in the present study. This would be expected to be positively related with systemic risk.

Laeven et al. (2016) have also considered deposits to total assets and loans & advances to total assets in their analysis. These have also been included in the present study, along with investments to total assets.

The study used a fixed effects panel regression model for explaining systemic risk, formulated as follows:

$$SRISK_{i,t} = a + \sum_j b_j x_{ij,t} + \sum_j c_j D_j + \sum_t d_t D_t + \epsilon_{i,t},$$

where the dependent variable on the LHS is the SRISK of the ith bank at time point t, $x_{ij,t}$ are the independent variables for the ith bank at time point t, the D_i represent the individual bank dummies, in order to capture the bank fixed effect, and the Dt represent the year dummies, in order to capture the year fixed effect. The model involved Net Non-Performing Assets to Net Advances taken with ln(total Assets), Capital Adequacy Ratio, Leverage, Deposits to Total Assets, Loans & Advances to

Total Assets, and Investments to Total Assets, with interactions. If the model is re-expressed as:

$$SRISK_{i,t} = a + \sum_j b_i x_{ij,t} - (c + \sum_j c_j x_{ij,t}) NNPLNA_{i,t} + \epsilon_{i,t},$$

with $a + \sum_j b_i x_{ij,t} < 0$ and $c + \sum_j c_j x_{ij,t} < 0$, the condition for neutral systemic risk is given by:

$$NNPLNA_i \leq \frac{a + \sum_j b_i x_{ij,t}}{c + \sum_j c_j x_{ij,t}}.$$

This condition gives a simple way to set maximum non-performing loans limits for banks.

Findings

The descriptive statistics for the variables are presented in Tables 1 and 2.

Table 1. Descriptive Statistics of SRISK and Its Determinants for Private Sector Banks

	Mean	*St. Dev.*	*Min*	*Max*
SRISK ($ m)	-2841.41	5079.93	-25319	3100
Net Non-Performing Loans to Net Advances	0.83	0.81	0.00	4.31
ln(Total Assets)	13.63	1.11	11.62	15.80
Capital Adequacy Ratio	14.78	2.33	11.03	22.46
Leverage	8.50	6.05	1.89	27.68
Deposits to Total Assets	0.76	0.11	0.52	0.90
Loans & Advances to Total Assets	0.58	0.04	0.47	0.68
Investments to Total Assets	0.30	0.04	0.20	0.43

Table 2. Descriptive Statistics of SRISK and Its Determinants for Public Sector Banks

	Mean	*St. Dev.*	*Min*	*Max*
SRISK ($ m)	1940.70	2120.98	-122	14521
Net Non-Performing Loans to Net Advances	1.99	1.77	0.15	11.89
ln(Total Assets)	14.32	0.86	12.50	16.93
Capital Adequacy Ratio	11.92	1.05	9.44	15.00
Leverage	29.31	15.92	7.83	103.85
Deposits to Total Assets	0.84	0.05	0.42	0.91
Loans & Advances to Total Assets	0.62	0.03	0.51	0.70
Investments to Total Assets	0.26	0.03	0.16	0.34

The private sector banks had a negative average SRISK and a negatively-skewed distribution of SRISK, while the public sector banks had a positive average SRISK and a positively-skewed distribution of SRISK. Private sector banks also had lower net non-performing assets to net advances than public sector banks, while public sector banks had higher leverage and lower capital adequacy than private sector banks. There was not much of a difference between public and private sector banks in terms of size, deposits to total assets, loans & advances to total assets, and investments to total assets.

The relationship between non-performing loans and SRISK for private sector and public sector banks is presented in Figure 1.

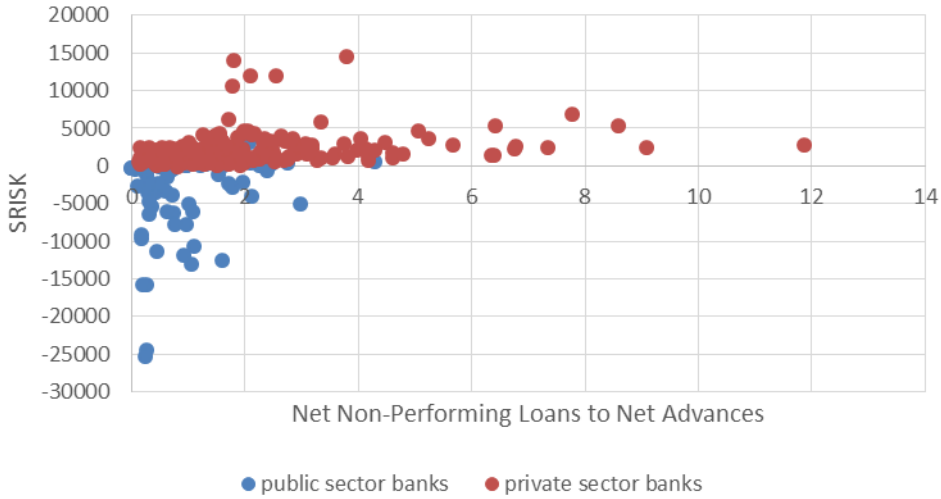

Figure 1. Non-Performing Loans and SRISK for Private Sector and Public Sector Banks

The results of fixed effects panel regression models, overall and for private sector banks and public sector banks separately, are presented in Tables 3, 4, and 5. For simplicity, only significant determinants were considered in each of the models.

Table 3. SRISK on Net Non-performing Loans to Net Advances (Overall)

	F Stat
[Intercept]	37157.643**
Net Non-Performing Assets to Net Advances	-10559.373**
ln(Total Assets)	-1400.576*
ln(Total Assets)* Net Non-Performing Assets to Net Advances	300.904**
Capital Adequacy Ratio	-474.927**
Capital Adequacy Ratio*Net Non-Performing Assets to Net Advances	219.268**
Loans to Total Assets	-25474.616**
Loans to Total Assets* Net Non-Performing Assets to Net Advances	7424.858**
between-subjects effects	coefficients
Net Non-Performing Assets to Net Advances	24.928**
ln(Total Assets)	2.061*
ln(Total Assets)* Net Non-Performing Assets to Net Advances	7.619**
Capital Adequacy Ratio	16.083**
Capital Adequacy Ratio*Net Non-Performing Assets to Net Advances	15.212**
Loans to Total Assets	16.572**
Loans to Total Assets* Net Non-Performing Assets to Net Advances	14.281**
bank fixed effects	13.047**
year fixed effects	7.414**
R^2	80.8%

Table 4. SRISK on Net Non-performing Loans to Net Advances (Private Sector)

	F Stat
[Intercept]	30159.632**
Net Non-Performing Assets to Net Advances	-21162.751*
ln(Total Assets)	
ln(Total Assets)* Net Non-Performing Assets to Net Advances	
Capital Adequacy Ratio	-359.643*
Capital Adequacy Ratio*Net Non-Performing Assets to Net Advances	229.784*
Loans to Total Assets	-52444.636**
Loans to Total Assets* Net Non-Performing Assets to Net Advances	33538.109**
between-subjects effects	coefficient
Net Non-Performing Assets to Net Advances	6.735**
ln(Total Assets)	
ln(Total Assets)* Net Non-Performing Assets to Net Advances	
Capital Adequacy Ratio	2.869*
Capital Adequacy Ratio*Net Non-Performing Assets to Net Advances	1.753*
Loans to Total Assets	11.792**
Loans to Total Assets* Net Non-Performing Assets to Net Advances	7.532**
bank fixed effects	16.547**
year fixed effects	3.171**
R^2	79.9%

Table 5. SRISK on Net Non-performing Loans to Net Advances (Public Sector)

	F Stat
[Intercept]	1584.682
Net Non-Performing Assets to Net Advances	-1038.700*
ln(Total Assets)	
ln(Total Assets)* Net Non-Performing Assets to Net Advances	
Capital Adequacy Ratio	-209.701*
Capital Adequacy Ratio*Net Non-Performing Assets to Net Advances	102.682*
Loans to Total Assets	2769.253*
Loans to Total Assets* Net Non-Performing Assets to Net Advances	3.779
between-subjects effects	coefficient
Net Non-Performing Assets to Net Advances	2.967*
ln(Total Assets)	
ln(Total Assets)* Net Non-Performing Assets to Net Advances	
Capital Adequacy Ratio	1.947*
Capital Adequacy Ratio*Net Non-Performing Assets to Net Advances	3.374*
Loans to Total Assets	0.190*
Loans to Total Assets* Net Non-Performing Assets to Net Advances	0.001
bank fixed effects	17.324**
year fixed effects	3.256**
R^2	73.8%

The overall results indicate a significant negative impact of non-performing loans, size, capital adequacy, and loans to total assets on systemic risk, with significant positive interaction effect between non-performing loans and size, capital adequacy, and loans to total assets. The maximum net non-performing loans to net advances for neutral systemic risk were found to be 2.31%.

The results for private sector banks indicate a significant negative impact of non-performing loans, capital adequacy, and loans to total assets on systemic risk, with significant positive interaction effect between non-performing loans and capital adequacy and loans to total assets. The maximum net non-performing loans to net advances for neutral systemic risk for private sector banks were found to be 2.00%.

The results for public sector banks indicate a significant negative impact of non-performing loans and capital adequacy on systemic risk, and a significant positive impact of loans to total assets on systemic risk, with significant positive interaction effect between non-performing loans and capital adequacy. The maximum net non-performing loans to net advances for neutral systemic risk for private sector banks was found to be -0.75%.

Discussion and Conclusion

The study contributes to the literature by proposing the concept of maximum level of net non-performing loans for neutral systemic risk, which is the level of net non-performing loans to net advances for which the systemic risk is non-positive. This arises from the positive relationship between systemic risk and non-performing loans, as discussed in the methodology.

The results of the study indicate that non-performing loans has a significant negative impact on systemic risk. Further, many of the variables considered were significant moderators of the relationship between capital adequacy and systemic risk. Bank size was found to have a significant negative impact on systemic risk and a significant positive interaction effect with non-performing loans. Capital adequacy was found to have a significant negative impact on systemic risk and a significant positive interaction effect with non-performing loans. Loans to total assets were found to have a significant negative impact on systemic risk, and it had a significant positive interaction effect with non-performing loans. Similar results held for private sector banks and public sector banks separately, except that bank size was no long significant. Also, specifically for public sector banks, loans to total assets were found to have a significant positive impact on systemic risk and no significant interaction with non-performing loans.

There were significant fixed effects in the final panel regression model. The bank fixed effects were found to be significant, indicating that there were significant differences in systemic impact between the banks. In particular, the banks with highest systemic impact were State Bank of India, Bank of Baroda, and Canara Bank (all of which are public sector banks), while the banks with least systemic impact were HDFC Bank, Kotak Mahindra Bank, and ICICI Bank (all of which are private sector banks). The year fixed effects were also found to be significant, indicating significant differences in systemic impact over time. Of course, systemic impact was high in the crisis period of 2008-09, and there was found to be a significant increase in systemic impact in 2012-14 as compared with previous years.

The results of the study give a range of estimates for the maximum net non-

performing loans to net advances for neutral systemic risk. In particular, for public sector banks, the maximum net non-performing loans to net advances for neutral systemic risk was found to be negative, suggesting that public sector banks should reduce their loans and advances in order to control their systemic risk. Also, instead of setting fixed net non-performing loans to net advances level for all banks, the model can be used to set the maximum net non-performing loans to net advances for neutral systemic risk for individual banks with estimates or projections of the bank's characteristics.

There are some limitations inherent in the study. The sample considered for the study was relatively small, and consisted of the relatively larger Indian banks. Also, the global financial crisis and Euro-zone crises had taken place during the study period, possibly contaminating the results. Further, there could be some multicollinearity between the variables, since many of the measures considered are related. For example, non-performing loans has worsened in recent years, so that the significance of non-performing loans could have been affected by the year fixed effect. The results of the study thus need to be tested for robustness. There is great scope for extending the study by including other possible determinants of systemic risk. Also, as most of the variables were found to be insignificant in the models for public sector banks, the determinants of systemic risk in public sector banks should be analysed more carefully. Perhaps forming clusters of banks with similar trends in systemic risk and analysing determinants of systemic risk within clusters would yield better results.

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