Journal of Banking and Finance Management
Volume 2, Issue 1, 2019, PP 13-20

Determinants of Positive Systemic Impact of Banks In India

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ABSTRACT

This study examines the determinants of positive systemic impact for banks in India. The independent variables considered for the study include the sector, bank size, return on assets, beta, leverage, capital adequacy, non-performing assets, price to book value, deposits, loans & advances, investments, net interest income, and non-interest income. A linear discriminant analysis model was applied in the study.
The results of the study indicate that leverage, deposits, loans & advances, investments, return on assets, and non-performing assets are the major discriminators between banks with positive systemic impact and those with non-positive systemic impact. The results of the study also suggest differences in the determinants of positive systemic impact between public sector banks and private sector banks.
Keywords: *determinants of positive systemic impact, linear discriminant analysis,public and private sector banks. India.*

INTRODUCTION

Systemic risk represents 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 interlinked financial intermediaries. The failure of an institution leads to financial stress on institutions that have lent money to it, which in turn may lead to failure of some of these institutions. this leads to a kind of domino or ripple effect, and spreads across the entire financial system.

The recent experience of the global financial crisis of 2008-09 and the subsequent Euro-zone crises of 2010-11 has demonstrated the importance of measuring the level of systemic risk associated with different financial institutions and understanding the factors contributing to systemic risk.The collapse of some of the most prominent banks in the world, including the Lehman Brothers and Washington Mutual Bank, along with several near-failures which had to be bailed out of crisis by the U.S. Government, highlighted the significance of understanding, measuring, and monitoring systemic risk.

Several economists have suggested that undercapitalisation of large financial institutions can result in financial instability, particularly when the entire financial system is undercapitalised. This is leads to the concept of "too big to fail" (TBTF), i.e. that large financial institutions are so systemically important that they cannot be allowed to fail. A similar concept is that of "too interconnected to fail" (TICTF), i.e. that financial institutions that are highly inter-connected with other institutions are very systemically important and so cannot be allowed to fail.

A question that several authors have posed is: which financial institutions should be bailed out in the event of a solvency/liquidity crisis (e.g. Acharya et al, 2012)? This logically requires identifying which institutions are critical to stability of the financial system, i.e. "systemically important." According to the Basel Committee on Banking Supervision (BCBS), the concept of systemic importance should be measured in terms of the potential impact of the failure of a bank on the global financial system and wider economy, rather than just the risk that a failure can occur (Moore and Zhou, 2014).

There are many theories suggesting that large and complex banks contribute to systemic risk. A possible root for the systemic importance of large, inter-connected banks is moral hazard; as regulators are reluctant to close or unwind 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 possibility is that of agency effects, i.e. that poor governance of large and complex banks can lead to bank managers engaging in non-traditional risky activities (for example, 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, 2012).

The Indian banking system, which was initially hailed to be unaffected by the crises, was affected indirectly, mainly on account of growing trade and financial integration with the global economy. Though Indian banks were not pushed to the point of insolvency, monitoring of systemic risk has become important in the dynamic banking environment in India in order to avoid potential system failure. This study examines the determinants of positive systemic impact for Indian banks.

The Indian banking industry has two important 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 argued 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).In view of this, the determinants of positive systemic impact would be expected to differ between public sector and private sector banks.

LITERATURE REVIEW

Measurement of Systemic Risk

There are many definitions of systemic risk and systemic importance advocated in the literature, and many more approaches proposed for their measurement.

Adrian and Brunnermeier (2008) was one of the first authors to suggest a measure for systemic risk, viz. the conditional value-at-risk (CoVaR), which focuses on the tail distribiution. They were able to identify the contribution of each bank to systemic risk using this measure.

Acharya et al (2010a, 2010b)proposed the concept of systemic expected shortfall (SES), i.e. the amount by which a bank is undercapitalised in a systemic event in which the entire financial system is undercapitalised, to measure systemic risk. Acharya and Steffan (2012) extended the framework by introducing the concepts of marginal expected shortfall (MES), which measures the performance of a bank when the market return as a whole experiences its worst 5% trading days within a year, and the bank's market leverage ratio (LVG), the market value of assets divided by the market value of equity.

Brownlees and Engle (2012, 2017) and Acharya et al (2012) suggested the SRISK index, which estimates the expected capital shortage of a bank during on a substantial market meltdown, as a measure for systemic risk.

Hautsch et al (2013, 2015) used a parsimonius econometric approach to measure systemic risk, the realised systemic risk beta, viz. the total effect of a bank's VaR on the VaR of the entire financial system, taking into account the bank's network relationships.

Suh et al (2013) proposed a method for estimating systemic risk using credit default swaps. Their method had the added advantage of being able to measure systemic risk contributions in both directions, i.e. the overall effect of systemicrisk on individual credit risks and vice versa.

Karimalis and Nomikos (2014) proposed a methodology for estimating the CoVaR, i.e. the Value-at-Risk of the financial system conditional on the failure of a financial institution based on copula functions, and extended thisapproach to estimate other conditional risk measures such as Conditional Expected Shortfall (CoES).

Moore and Zhou (2014) proposed the expected system loss (ESL), viz. the expected loss to the financial system as a whole given that a particular bank fails, which they estimated using multivariate extreme value theory, as a measure of systemic importance of the bank.

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.

van Oordt and Zhou (2015) analysed bank systemic risk into two dimensions, the level of bank tail risk and the linkage between the level

of bank tail risk and severe financial shocks to the system.

Determinants of Systemic Risk

Several studies have analysed the determinants of systemic risk and systemic importance of banks.

Stolbov (2012) examined macro-determinants of systemic risk for some major economies. He found that gross government debt to GDP, state fragility index, EU membership, and world gross GDP share are key determinants of systemic risk for the sovereign CDSprices, while stock market total value traded to GDP, state fragility index, and financial openness index are the key determinants of systemic risk in the stock market.

Moore and Zhou (2014) found that size and non-traditional banking activities were the significant determinants of systemic importance of US banks in the period 2000-10; in particular, they found that banks above a certain size have equal systemic importance.

Bostandzic et al (2014) found that banks with higher levels of Tier 1 capital had lower exposure and contribution to global systemic risk. Further, they found that banksize and interconnectedness are positively related to global financial fragility. They also found that deposit insurance schemes that require banksand depositors to bear more financial risk are associated with greater vulnerability andcontribution to a crisis of the financial sector.

vanOordt and Zhou (2015) found 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.

Laeven et al (2016) found that systemic risk increases with bank size and is inversely related with bank capital; in particular, low capital in large banks is the key driver of systemic risk. Further, they found that market-based activities and country characteristics have moderating effect on these relationships.

Anghelache and Oanea (2016) found that financial leverage, size, risk, and market to book value had a significant impact on systemic risk contribution of Romanian commercial banks.

Methodology

The objective of the study is to analyse the determinants of positive systemic impact for banks in India. Due to the wide differences in performance between public sector and private sector banks, the determinants of positive systemic impact would be expected to differ between public sector and private sector banks.

The study was conducted using sample of thirty-one Indian banks, including twenty-one public sector banks, and ten private sector banks. The list of sample banks is given in the table below.

Public sector banks	Private sector banks
Allahabad Bank	Axis Bank Ltd
Andhra Bank	Federal Bank Ltd
Bank of Baroda	HDFC Bank Ltd
Bank of India	ICICI Bank Ltd
Bank of Maharashtra	IndusInd Bank Ltd
Canara Bank	Jammu & Kashmir Bank Ltd
Central Bank of India	Karnataka Bank Ltd
Corportaion Bank	KarurVysya Bank Ltd
Dena Bank	Kotak Mahindra Bank Ltd
IDBI Bank Ltd	Yes Bank Ltd
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	
Vijaya Bank	

The data pertaining to bank characteristics was collected from the Capitaline database[1]. The

SRISK estimates were collected from NYU Stern's V-Lab database[2]. The study period was 2007-16.

The dependent variable considered for the study was positive systemic impact, based on the measure of systemic risk proposed by Brownleesand Engle (2012), SRISK. This index measures the expected capitalshortage faced by a bank during a period of system distress when the market declinessubstantially. It is estimated as

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

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 marketdecline

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

Note that SRISK can take negative values. A bank with negative SRISK represents a well-capitalised bank with large enough capital buffers to easily absorb systemic shocks. The total systemic risk in the financial system is measured by aggregating the positive SRISK contributions of different financial institutions. Banks with positive SRISK were taken to have positive systemic impact. The independent variables considered for the study ae 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, 2014). 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. Another common determinant is capital adequacy (Laeven et al, 2014). The measure for capital adequacy used for the study is the Capital Adequacy Ratio. It is expected that higher levels of capital adequacy would be associated with a lower systemic impact.

Non-performing loans is an important determinant (van Oordt and Zhou, 2015), and would be expected to play a role in increasing systemic risk particularly for public sector banks. The measure considered in the study is the Net Non-Performing Loans to Net Advances.

Two other important determinants are beta and leverage (Anghelache and Oanea, 2016). These have also been included in the present study. Both would be expected to be positively related with systemic impact.Bank profitability may also be related with systemic impact. In the present study, it is measured by the return on assets of the bank. Non-interest income has been found to be a significant determinant of systemic impact in several studies (Moore and Zhou, 2013; van Oordt and Zhou, 2015), positively related with systemic impact. This was measured in the present study using the Non-Interest Income to Total Funds ratio. Along with this, the Net Interest Income to Total Funds ratio is also considered. Laeven et al (2014) 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. Bostandzic et al (2014) have also considered the valuation ratios as potential determinants of systemic impact. The price to book value ratio has been considered in the present study. The study used a linear discriminant analysis model for explaining positive systemic impact, formulated as follows:

$$D_{i,t} = a + \sum_i b_i(1+S)x_{i,t} + \sum_i c_i I_i + tdtIt,$$

where the LHS is the discriminant score of the ith bank at time point t, $x_{i,t}$are the independent variables for the ith bank at time point t, S is a dummy variable for public sector banks (S = 1) against private sector banks (S = 0), the $I_i$are the individual bank dummies, and the $I_t$are the year dummies.

Findings

The descriptive statistics for the variables are presented in Table 1 below.

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 higher return on assets, capital adequacy, price to book value ratios, net interest income to total funds, and non-interest income to total funds than public sector banks, while public sector banks had higher leverage and net

[1]www.Capitaline.com
[2]https://vlab.stern.nyu.edu/analysis/RISK.WORLDFIN-MR.GMES

non-performing assets to net advances than private sector banks. There was not much of a difference between public and private sector banks in terms of size, beta, deposits to total assets, loans & advances to total assets, and investments to total assets.

Table 1: *descriptive statistics of SRISK and its determinants*

	public sector				private sector			
	Mean	**St. Dev.**	**Min**	**Max**	**Mean**	**St. Dev.**	**Min**	**Max**
SRISK ($ m)	1940.70	2120.98	-122	14521	-2841.41	5079.93	-25319	3100
ln(Total Assets)	14.32	0.86	12.50	16.93	13.63	1.11	11.62	15.80
Return on Assets	0.72	0.51	-1.25	2.50	1.39	0.40	0.34	2.02
Beta	0.80	0.22	0.22	1.41	0.84	0.27	0.24	1.57
Leverage	29.31	15.92	7.83	103.85	8.50	6.05	1.89	27.68
Capital Adequacy Ratio	11.92	1.05	9.44	15.00	14.78	2.33	11.03	22.46
Net Non-Performing Assets to Net Advances	1.99	1.77	0.15	11.89	0.83	0.81	0.00	4.31
Price to Book Value Ratio	0.87	0.42	0.26	2.70	2.47	1.79	0.46	9.58
Deposits to Total Assets	0.84	0.05	0.42	0.91	0.76	0.11	0.52	0.90
Loans & Advances to Total Assets	0.62	0.03	0.51	0.70	0.58	0.04	0.47	0.68
Investments to Total Assets	0.26	0.03	0.16	0.34	0.30	0.04	0.20	0.43
Net Interest Income to Total Funds	2.46	0.52	0.59	3.66	3.15	0.86	1.07	5.62
Non-Interest Income to Total Funds	0.97	0.27	0.45	1.83	1.61	0.52	0.52	2.63

The results of the discriminant analysis are presented in Table 2 below.

Table 2: *discriminant analysis results*

	Full Model		Stepwise Model	
	Coeff	**StdCoeff**	**Coeff**	**StdCoeff**
ln(Total Assets)	0.064	0.064		
sector* ln(Total Assets)	-0.007	-0.030		
Return on Assets	-2.393	-1.105	-2.893	-1.336
sector* Return on Assets	2.291	1.074	2.952	1.384
Beta	-0.408	-0.094		
sector*Beta	0.416	0.122		
Leverage	0.420	5.807		
sector*Leverage	-0.414	-6.487		
Capital Adequacy Ratio	0.082	0.131		
sector* Capital Adequacy Ratio	-0.120	-0.436		
Net Non-Performing Assets to Net Advances	-0.594	-0.919		
sector* Net Non-Performing Assets to Net Advances	0.539	0.855		
Price to Book Value Ratio	0.081	0.076	-0.317	-0.297
sector* Price to Book Value Ratio	-0.337	-0.148		
Deposits toTotal Assets	0.789	0.056	6.321	0.446
sector* Deposits toTotal Assets	-2.200	-0.560	-7.338	-1.869
Loans& Advances toTotal Assets	-11.204	-0.417	-7.774	-0.290
sector* Loans& Advances toTotal Assets	10.405	1.943	8.774	1.638
Investments toTotal Assets	-11.164	-0.416		
sector* Investments toTotal Assets	8.685	0.711		
Net Interest Income to Total Funds	0.224	0.137		
sector* Net Interest Income to Total Funds	-0.042	-0.035		
Non-Interest Income to Total Funds	0.346	0.127		
sector* Non-Interest Income to Total Funds	-0.091	-0.033		
(Constant)	3.025		1.780	
Functions at Group Centroids				
positive SRISK	-4.524		-3.529	
non-positive SRISK	1.400		1.092	
Canonical correlation	0.930		0.892	
Wilks' lambda	0.136		0.205	

p-value	0.000		0.000	
%age correctly classified	97.6%		95.9%	

Leverage was found to be a major discriminator between banks with positive systemic impact and those with non-positive systemic impact. In particular, private sector banks with higher leverage were more likely not to have positive systemic impact, and for public sector and private banks with the same level of leverage, the public sector banks were more likely than the private sector banks to have positive systemic impact.

Loans and advances to total assets was also a major discriminator. In particular, public sector banks with higher loans & advances to total assets ratios were more likely not to have positive systemic impact, while private sector banks with higher loans & advances to total assets ratios were more likely to have positive systemic impact.

Return on assets was also a major discriminator. In particular, private sector banks with higher return on assets were more likely to have positive systemic impact, and for public sector and private banks with the same level of return on assets, the private sector banks were more likely than the public sector banks to have positive systemic impact.

Net non-performing assets to net advances was also a major discriminator. In particular, private sector banks with higher net non-performing assets to net advances were more likely to have positive systemic impact, and for public sector and private banks with the same level of net non-performing assets to net advances, the private sector banks were more likely than the public sector banks to have positive systemic impact.

Deposits to total assets was also a major discriminator. In particular, public sector banks with higher deposits to total assets ratios were more likely to have positive systemic impact, and for public sector and private banks with the same level of deposits to total assets, the public sector banks were more likely than the private sector banks to have positive systemic impact.

Investments to total assets was also a major discriminator. In particular, public sector banks with higher investments to total assets ratios were more likely not to have positive systemic impact, while private sector banks with higher investments to total assets ratios were more likely to have positive systemic impact.

Capital adequacy ratio was also a major discriminator. In particular, public sector banks with higher capital adequacy ratios were more likely to have positive systemic impact, and for public sector and private banks with the same level of capital adequacy, the public sector banks were more likely than the private sector banks to have positive systemic impact.

Other variables were not found to be major discriminators between banks with positive systemic impact and those with non-positive systemic impact.

Using stepwise discriminant analysis, the only significant discriminators between banks with positive systemic impact and those with non-positive systemic impact were found to be the deposits to total assets ratio, the loans & advances to total assets ratio, the return on assets, and the price to book value ratio. Banks (public and private sector) with higher price to book value ratio are more likely to have positive systemic impact.

The results of the discriminant analysis for public sector and private sector banks separately are presented in Table 3 below.

Table 3: discriminant analysis results for public sector banks and private sector banks

	public sector banks		**private sector banks**	
	Coeff	**StdCoeff**	**Coeff**	**StdCoeff**
ln(Total Assets)	0.203	0.179	0.076	0.079
Return on Assets	-0.407	-0.206	-1.714	-0.536
Beta	0.096	0.021	-0.324	-0.086
Leverage	0.038	0.615	0.298	1.028
Capital Adequacy Ratio	-0.292	-0.309	0.065	0.144
Net Non-Performing Assets to Net Advance	-0.307	-0.551	-0.396	-0.299
Price to Book Value Ratio	-1.570	-0.659	0.056	0.086
Deposits to Total Assets	-10.874	-0.591	0.981	0.092
Loans & Advances to Total Assets	-12.028	-0.380	-6.351	-0.262
Investments to Total Assets	-19.964	-0.602	-6.191	-0.266

Net Interest Income to Total Funds	1.213	0.614	0.146	0.115
Non-Interest Income to Total Funds	1.055	0.283	0.337	0.163
(Constant)	19.446		2.100	
Functions at Group Centroids				
positive SRISK	-2.631		-1.021	
non-positive SRISK	0.027		2.533	
Canonical correlation	0.258		0.852	
Wilks' lambda	0.933		0.275	
p-value	0.362		0.000	
%age correctly classified	89.9%		97.9%	

For public sector banks, the major discriminators were price to book value ratio (increasing the likelihood of positive systemic impact), leverage (decreasing the likelihood of positive systemic impact), net interest income to total funds (decreasing the likelihood of positive systemic impact), investments to total assets (increasing the likelihood of positive systemic impact), deposits to total assets (increasing the likelihood of positive systemic impact), and net non-performing assets to net advances (increasing the likelihood of positive systemic impact). For private sector banks, the major discriminators were leverage (decreasing the likelihood of positive systemic impact), and return on assets (increasing the likelihood of positive systemic impact).

DISCUSSION

The results of the study suggest that leverage is the most important discriminating factor for positive systemic impact, with banks with higher leverage being less likely to have positive systemic impact. This is somewhat contrary to logic, but it may be that banks with high leverage are subject to more stringent capital control, so that the effect is reversed. The results of the study also suggest that capital adequacy does not have much of an effect on systemic impact, which is again contrary to economic logic.This would have to be investigated further to understand the interlinkage between leverage, capital adequacy, and liquidity. In particular, this would have important policy implications for the regulation of bank capital and leverage.

The results of the study showed an interesting triangle of deposits, loans & advances, and investments. Public sector banks with higher deposits to total assets ratios were more likely to have positive systemic impact, while public sector banks with higher loans & advances to total assets ratios or higher investment to total assets ratios are less likely to have positive systemic impact, and vice versa for private sector banks. This is intuitively logical, as deposits are liabilities for a bank - in the event of the failure of a bank with higher deposits ratio, it becomes more difficult to recover the deposits, thus yielding a greater systemic impact; on the other hand, loans & advances and investments are assets for a bank, so the opposite effect holds. Interestingly, however, the same triangle was not as important in private sector banks.

The results of the study also indicated that private sector banks with higher net non-performing assets to net advances are more likely to have positive systemic impact, as would be expected; however, this was not conclusive for public sector banks, for which non-performing assets are much more of a problem.Again, there could be some stringent capital controls that are administered in case of high non-performing assets, which may nullify the effect. The results of the study also suggested that private sector banks with higher return on assets were more likely to have positive systemic impact; however, this was not conclusive for public sector banks.

Interestingly, the results of the study are contrary to the size effect and the non-traditional banking effect as suggested by Moore and Zhou (2014). Size and non-interest income did not have much of a discriminating effect between banks with positive systemic impact and those with non-positive systemic impact. 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, since many of the measures considered are related.The results of the study thus need to be tested for robustness.

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Citation: *Mihir Dash"Determinants of Positive Systemic Impact of Banks In India", Journal of Banking and Finance Management, vol. 2, no. 1, pp. 13-20,2019.*