

Mathematical Analysis of Resilience during the Global Financial Fragility

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Abstract – We determine mathematically how resilience is maintained by banks during global crisis.

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context which was proved by the Global Trust Bank that became insolvent in 2004.

INTRODUCTION

A popular measure of a bank's bankruptcy is the Z-Index. The Z-Index as a measure of insolvency risk, suggested by Hannan and Hanweck (1988) and subsequently used by Liang & Savage (1990), Eisenbeis & Kwast (1991), Sinvey & Nash (1993), Bichsel and Blum (2004), Naimy (2005), Rahman et al. (2009) and Sinha et al. (2010), takes into consideration banks' return on assets, volatility of return and the capital base. In spite of its simplicity, it is widely used as it can be calculated using only accounting information and thus applicable for both listed and unlisted financial institutions (Strobel, 2011).

Bichsel and Blum (2004) extended their study conducted in 2002 in examining the relationship between bank capital and default risk. An option-based default metric was computed for Jamaican banks using a Merton-type model. This indicator accurately tracks the default experience for Jamaican banks over important periods in the 1996 to 2004 sample. However, the study did not uncover a significant relationship between either bank capital and asset risk or bank capital and the likelihood of default. Additionally, contrary to previous research, it was found that a higher volatility in equity prices is associated with a lower default probability.

A study was conducted by Naimy (2005) on overall performance of the Lebanese Banks in terms of profitability and risks for the period 1993 to 2002. He used Du Pont equation to measure profitability and risk index suggested by Hannan and Hanweck (1988) to measure risk of Lebanese commercial banks.

Rahman, Ibranim and Meera (2009) conducted a study to investigate the impact of lending structure on the insolvency risk exposure. For this a comparative analysis between the insolvency risk behavior between the Islamic and conventional banks is made. The findings of this study was that the real estate lending is positively related to the conventional banks' risk, but inversely related to Islamic banks' risk exposure.

Sinha, Taneja and Gothi (2010) carried out a study using the Z score for a sample of 15 Indian public and private banks for a period of 3 years. They concluded that the Z score developed by Hannan and Hanweck (1988) to measure the insolvency risk is also relevant in the Indian

II. PROBABILISTIC INTERPRETATION OF BANKRUPTCY

If we want to capture the overall risk of a bank, the variability of ROA provides a comprehensive measure that reflects not only credit risk but also interest rate risk, liquidity risk and any other risk that is realized in bank earnings. The standard deviation of ROA is a good measure of the variability of ROA.

Thus, the Z-Index is a function of the normal profit margin of the bank, the variation in that profit margin, and the equity capital available to absorb that variation. In effect, the Z-ratio measures the number of standard deviations by which ROA would have to decline before the book equity capital of the bank would be exhausted. The relationship between the Z-ratio and the probability of bankruptcy is an inverse one, with higher Z-ratios indicating a lower probability of bankruptcy.

Researcher has estimated the Z-indices for public, private and foreign sectors banks operating in India for the stated period and for every value of Z (assuming a symmetric distribution), the perceived probability (upper bound) of bankruptcy (P) is calculated as under:

$$P = \frac{\left(\frac{1}{2}\right) \times \sigma^2_{ROA}}{(ROA + CTA)^2}$$

where the multiplication by (1/2) reflects the fact that bankruptcy occurs only in the left tail of the distribution. The relation of P to Z is inverse one, with higher Z-ratios indicating low probability of bankruptcy.

III. EMPIRICAL OBSERVATIONS

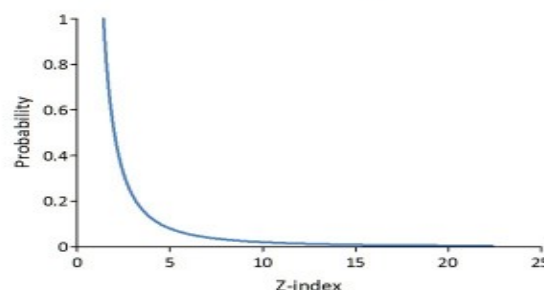
Table 1 shows the Z-Index and probability of bankruptcy (P) of public sector banks, private sector banks and foreign banks during the period 2005-06 and 2009-10. It is evident from the table that average ROA of both public sector banks (0.00953) and private sector banks (0.00989) is almost equal, but it is considerably higher in case of foreign banks (0.01733). In case of CTA, significant higher value is observed for foreign banks (0.43693) as compared to private sector banks (0.14783) and public sector banks (0.12598). But Z statistic of foreign sector banks (51.85996) is much greater than that of other two bank groups –private sector banks (26.50587)

and public sector banks (45.91684). The reason is due to the difference in the variability of ROA as measured by the standard deviation. While S.D. of ROA is only 0.00300 in case of public sector banks, it is very high of 0.01581 for foreign banks. It is also higher in case of private sector banks (0.00644) as compared to public sector banks. This significant difference in the variability of ROA leads to lower Z statistic despite higher ROA and CTA of foreign banks and private sector banks. Thus, the observed Z-Index indicate that the public sector banks are safer as in comparison to private sector and foreign banks. The probability of book value bankruptcy as shown in the table also depicts the same.

Among the public sector banks, average performance of state bank group is better than the nationalized banks in terms of maintaining sound financial health. While Z statistic for state bank group is found to be 111.87044, it is 66.48666 for nationalized banks during the study period. By maintaining almost same capital base, SBI Group could improve its Z statistic by increasing μ_{ROA} and lowering variability of ROA. Among the private sector banks, the probability of book value bankruptcy is lower for old private sector banks than the new private sector banks. As far as the Z-Index for foreign banks is concerned, it is highest (51.85996) among three Indian banking groups. In this context a study conducted by Jordan (1998) may be considered. He found that a failed bank had an average individual Z-Index of 21.22 and for survivor it was 37.62. In case of bank groups, it was 8.71 for failed banks and 13.33 for non-failed bank. Though the socio-economic conditions, customer expectations, use of technology etc. are not same in case of India and hence the Z-Index may be different to classify a bank / bank group

as failed or non-failed. But for analytical purpose if use the findings of Jordon (1998) as yardstick, then it is evident that none of the bank groups operating in India may be considered as failed bank group.

Chart 1: Probability of Insolvency and the Z-Index



A look into the top five banks (Table 2) in respect of Z-Index out of the selected 80 banks for this study reveals that State Bank of Patiala occupied first position with a very high Z-Index of 341.5326. Out of the top five banks, two banks are private sector banks, more specifically old generation private sector banks. On the other hand, State Bank of Patiala and Corporation Bank are public sector banks. From the earlier discussion, it is evident that average Z-Index of new private sector banks and nationalised banks was much lower than that of SBI Group and old private banks. This indicates that some of the old private sector banks performed extremely well in the matter of managing sound financial health while others could not.

Table 2: Top Five Banks with Highest Z-Index

No.	Name of bank	μ_{ROA}	μ_{CTA}	σ_{ROA}	Z
1	State Bank of Patiala (PSB)	0.0079	0.13024	0.000424	341.5326
2	Corporation Bank (PSB)	0.0125	0.13552	0.000497	304.8748
3	Tamilnad Mercantile Bank Ltd. (PrSB)	0.01574	0.16418	0.000602	298.6250
4	Sonali Bank (FSB)	0.01686	0.4872	0.001757	286.8426
5	City Union Bank Ltd. (PrSB)	0.0153	0.12666	0.000557	254.9677

It is also evident from the Table 2 that very high Z-Index of State Bank of Patiala is due to lower variability of return [σ_{ROA}]. Average ROA of Corporation Bank (0.0125) is greater than that of State Bank of Patiala (0.0079), but the S.D. of ROA of the former bank is higher than the later. Similarly, Tamilnad Mercantile Bank Ltd. and Sonali Bank occupied 3rd and 4th position respectively by maintaining a steady return on assets over the years. Because the average ROA and average CTA of the banks are lower than other three top banks. Table 3 also depicts the same. Out of five banks having lowest Z-Index, two have negative average ROA and the variability of ROA is also very high.

This is also justified from the Table 3 that shows the list of five banks having lowest Z-Index. Out of five banks, Z statistic of American Express Banking Corporation and Barclays Bank PLC is very low, 2.535158 and 4.178429

respectively. In the list five banks having lowest Z-Index, only one private sector bank i.e. Development Credit Bank Ltd has been at poor performance depicting the Z-Index to be at 10.71472 and all other four banks belong to the foreign banking sector group of Indian banking.

Year-wise Z statistic and Probabilistic interpretation of book value insolvency for Indian banks as shown in Table 4 reveals that Indian banks have shown a fluctuating trend during the period of study in terms of financial stability. In case of public sector banks Z statistic increased from 35.93629 in 2005-06 to 46.13559 in 2009-10. Indeed during tough time for the world with respect to financial crisis, the Z statistic for Indian public sector banks has been almost consistent. In case of private sector banks, though increased from 15.61959 in 2005-06 to 21.62951 in 2009-10, show a fluctuating trend over the years. For instance, highest Z statistic is found in the year 2007-08

Table 4: Year-Wise Z-Index and Probability of Bankruptcy for Indian Banks

Year (End March)	Public Sector Banks		Private Sector Banks		Foreign Sector Banks	
	Z	P	Z	P	Z	P
2005-06	35.93629	0.00039	15.61959	0.00205	18.47865	0.001464
2006-07	55.16085	0.00016	31.82815	0.00049	19.40440	0.001328
2007-08	46.97276	0.00023	37.20365	0.00036	21.03992	0.001129
2008-09	45.37872	0.00024	26.24845	0.00073	22.35704	0.001000
2009-10	46.13559	0.00023	21.62951	0.00107	16.98353	0.001733

(37.20365), but in the immediately preceding year it came down to 26.24845. The probability of insolvency for private sector banks has been fluctuating with in the limits during the period of 5 years. In case of foreign banks, it increased from 18.47865 in 2005-06 to 22.35704 in 2008-09 with an increasing trend but it came down to 16.98353 in the last year of the study period. Overall a declining probability trend for insolvency is observed for the public sector banks and private sector banks during the study period as depicted in the Chart 2.

IV. CONCLUSION

Foreign sector banks operating in India showed a little worrisome trend with respect to the probability of book value insolvency which can be attributed to the small operational coverage in India. Except FSB a positive trend is found for all the bank groups in recent years that indicate a good sign for Indian commercial banks.

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