ASSETS AND LIABILITES INFORMATION ANALYSIS OF THE INDIAN PUBLIC SECTOR BANKS

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Abstract

This study attempts to find out behaviour of the banks with respect to their capital adequacy ratio dynamics, by decomposing the financial statements. We used information analysis of the balance sheet and a data set that spanned between 1998 and 2002, for twenty public sector banks. We found that information measures can explain banks' policy decisions on liabilities and assts reorganisation. Quantitatively, we found that proportional development took place, in both liabilities and asset items of the banks under different capital adequacy ratio values. Evidences did show that banks reorganised their assets and liabilities to achieve higher capital adequacy ratios, but such reorganisation did not result from a planned action of the banks, except in certain isolated cases. We also found that the assets reorganisation was more pronounced than the reorganisation of the liabilities. The study points out that the Reserve Bank of India is justified in enhancing the normative minimum CAR from 8% to 9% effective from the year 2000.

JEL Classification Code: C 29

Key words : Capital Adequacy Ratio, Information Measures, Entropy, Time Horizon Assets and Liabilities Measure.

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Introduction

Indian banking has a rather chequered history. In the early days of independence, that is, during 1950s, the banking activities were restricted to certain selected towns and metropolis. Banking services in rural and semi-urban areas were virtually non-existent. With the establishment of the State Bank of India in 1955, some concerted attempt was made to provide banking services in the rural areas. It is after the nationalisation of the banks that a thrust was made to expand banking services in rural areas. The banking resources were made available for meeting credit needs of the rural masses. Expanding banking services in hitherto unrepresented areas, financing agriculture and small-scale industries, setting up lead banks were some of the hallmarks of the new policy. In April 1980, six more banks were nationalised. An accelerated growth of banking activities took place and the banks became the major and dominant provider of the credit needs of the business and industry in the economy.

Soon, however, expansion led to interplay of dysfunctional forces in the economy and the banks increasingly found themselves in an economically precarious position. The crisis was heightened during 1990s and some of the banks were on the verge of collapse. Since, the Central Government were the owners of the banks, fortunately there was no run on the deposits. Internationally, meanwhile, Basle Committee on Banking Supervision announced (July 1988) risk-based capital standards for the banks. In India, recommendations of the Committee on Financial Sector Reforms were adopted and capital to risk-weighted assts norms were introduced for the banks from April 1992. It became mandatory for the banks to adhere to the minimum capital adequacy ratio of 8%

from 1992 onwards. This ratio was raised to 9% from the year 2000. The banking sector reforms attracted attention of the researchers worldwide, including India. The studies were related to prediction of bank failures, effects and progress of sectoral reforms affecting banks, etc.

Earlier studies

Risk based capital standards are fairly recent phenomenon, while earlier studies are focussed on bank failures. One of the earliest researches was due to Secrist (1938)[1], who used multivariate analysis to predict bank failures. Another noteworthy study was done by Meyer and Pifer (1970)[2]. Using paired sample technique and a sample of thirty-nine pairs of banks, solvent and failed during the period between 1948 and 1965, they constructed a linear regression model for the prediction of bank failures. The variables used were both dependent (dummy) and independent. Thirty-two financial measures were selected as independent variables. The model was successful in predicting approximately 80 percent of the sample banks, one to two years before failure. When the model was used to predict before three years or more, it performed poorly. Some of the variables that entered in the final regression equation are:

(i) Growth of consumer loan to total assets

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1. H. Secrist, National Bank Failures and Non-Failures, An Autopsy and Diagnosis (Bloomington, Indiana : Principa Press , 1938)
2. P.A. Meyer and H. W. Pifer, "Prediction of Bank Failures", *The Journal of Finance*, 25. September, 1980.

(ii) Coefficient of variation of total loans

(iii) Errors in predicting cash and securities to total assets.

Subsequently, the research focus was turned towards investigation of banks behaviour vis-à-vis capital adequacy standards. Some of the researches in this direction were due to Haubrich and Watchel (1993), Hanscock, Laing and Wilcox (1995), Wall and Peterson (1995), Peek and Rosengren (1995), Jacques and Nigro (1997), Editz, Michael and Perraudin (1998), Rime (1998) and Furfine (2000). In all the above studies, evidences were documented to show that introduction of risk-based capital requirements did have influences over banks' lending decisions and change of their portfolio compositions.

In India, researches in capital adequacy standards have been reported. In one such studies, Nachane, Narain, Ghosh and Sahoo (2000)[3], using regression model and conditioning variables, designed to proxy bank's internal capital target, documented evidences that capital requirements significantly affect bank's capital ratio decisions. However, to meet capital requirements approaching regulatory minimum, the banks did not significantly substitute high risk-weighted assets. They added, that profit played a dominant role in the adjustment of capital ratios and banks with higher levels of core capital could have been ploughing back their profits into reserves to raise overall capital levels. Importantly, they found no evidence to support the prevailing belief of shifting

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3. D. M. Nachane, A. Narain, S. Ghosh and S. Sahoo : " The Impact of Capital Requirements on Bank Behaviour : An Empirical Analysis of Indian Public Sector Banks", Reserve Bank of India, DRG Studies, RBI Website.

from loans to government securities for countering regulatory pressure. They concluded that capital adequacy requirement is an attractive regulatory instrument as it reinforces the stability of the banking system without apparently distorting lending choices of the banks. In another study by Nag and Das (2002)[4], mainly to investigate impact of imposition of capital requirement in the flow of bank credit, it was concluded that banks did shift their portfolio in a way that reduces their capital requirements. Using switching regression model and certain proxy measures, e.g., synthetic Index of Industrial Production, growth of non-SLR investments, they found a clear possibility of regulatory pressure acting as a controlling factor in the supply of credit to the commercial sector.

Meanwhile, the regulatory system has been strengthened and it is of interest now to investigate what factors influence the banks' behaviour in a regime of falling interest rates added with healthy growth of deposits. This study, therefore, seeks to find out, whether there is any linkage in the reorganisation of capital, liabilities and assets of the banks, having different capital adequacy ratios. Secondly, whether variations of capital adequacy ratios over time has any bearing on the liabilities and assets reorganisation of the banks. In order to investigate the banks' behaviour vis-à-vis variation of capital adequacy ratio over time, we used Informational Analysis. We reasoned that changes in balance sheet items of liabilities and assets effecting variations of capital adequacy ratio, would be better captured by the Information Analysis.

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4. A. K. Nag and A. Das : "Credit Growth and Response to Capital Requirements – Evidence from Indian Public Sector Banks", *Economic and Political Weekly*, August 10-16, 2002, pp. 3361-68.

The Model

The basic premise of the information theory is, that occurrence of an event may have several possibilities to which probabilities could be assigned. When information about the event is received these probabilities undergo changes. These changes in probabilities enable measurement of amount of information contained in the message. Mathematically[5], the information function could be expressed as:

$$h(p) = - \log p \; ; \qquad 0 \leq p \leq 1. \qquad (1)$$

The function monotonically decreases from $\propto$ to 0, that is, infinite information, when probability is zero and no (zero) information, when probability of occurrence of an event is 1(one).

Extending the concept to n events, given by E_1, E_2, …, E_n, with probabilities p_1, p_2,…,p_n, we find that since one of the events is bound to occur, all the probabilities, p_1, p_2….,p_n will sum to one. Now if the event E occurs, the amount of information in the message stating the occurrence of E is h (p_i) and the expected information content of the message,

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5. C. E. Shannnon : "A Mathematical Theory of Communication", *Bell System Technical Journal*, XXVII, 1948, pp. 315-33.

i.e., the entropy of the distribution with probabilities $p_1, p_2, \ldots, p_n$ is given by:

$$H(p_1, p_2, \ldots, p_n) = \sum_{i=1}^{n} p_i h(p_i) = -\sum_{i=1}^{n} p_i \log p_i ; \; p_i \geq 0 , \; \sum_{i=1}^{n} p_i = 1 \text{ and } p_i \log p_i = 0 , \text{ when } p_i = 0 \qquad (2)$$

In the same way, the expected information content of a non-definite message can be evaluated and is given by the following expression:

$$I = \sum_{i=1}^{n} q_i \log q_i/p_i, \qquad (3)$$

where, q_i is the changed probability of the original probability p_i, due to arrival of non-definite message in respect of event E.

The major constraint that is encountered in the application of information concept for the analysis of financial statements is the need to assign two sets of probabilities to all possible outcome, one before arrival of the message and the other, after it. If, for example, individual items of the balance sheet, like, fixed and current assets, capital and current liabilities are divided by their total; it would yield a set of non-negative fractions, which will sum to one. These fractions could then be regarded as probabilities, since the requirements of a probability distribution are the same, i.e., they are non-negative and sum to one. Statistically speaking, if the fixed assets yield a fraction denoted by 'p', then there is a probability of 'p' that a single rupee picked up at random from the balance sheet asset items would belong to fixed assets. Two sets of balance sheets would yield fractions that could be used as two sets of probabilities as mentioned above.

Assets and Liabilities Information Measures

In the balance sheet, let us denote fractions of assets decomposition by p_i, i = 1, 2, …, n (like p_1= cash & balance with RBI, p_2 = balance with banks, money at call), etc., and let us also denote the corresponding fractions of a later period assets side of the balance sheet as q_i, i = 1, 2, …, n, then the assets information measure I_A, would be:

$$I_A = \sum_{i=1}^{n} q_i \log q_i/p_i \qquad (4)$$

The details calculation of information measures of a sample bank is shown in Appendix A.

The assets information measures, as can be observed, reflect the variability of the individual asset items as contained in the two time-horizon balance sheets. The value of the measure will be zero, when the individual fractions of the two balance sheets items are identical, i.e., when $q_i = p_i$. The larger deviations of the two fractions (or the probabilities), would result in larger information measures. The measure would show the extent of deviations of the proportional development of the asset items. Higher and lower values would indicate relatively higher and lower reorganisation of the assets items between the two balance sheets. As Lev[6] puts ' the decomposition of the firm's assets represents the end result of managerial policy with respect to resources allocation. The assets information measures will therefore characterize, among other things, the degree of

6. B. Lev : 'Studies in Accounting Research #2', AAA, August 1969 p. 21.

change in this policy'. Therefore, an examination of assets information measures of a bank, would bring out, the extent of change of managerial policy to counter regulatory pressure of achieving the normative capital ratio. Significance of information analysis can be traced out to the fact that variations of financial statement items over time duly reflect occurrence of significant event that are caused by planned as well as ad-hoc or non-planned actions of the management.

In the same way we can calculate liabilities information measures. The basic properties of this measure are same as that of the assets information measure. It would similarly indicate degree of deviation on proportional basis of the liabilities occurred during the period covered by the two balance sheets.

Data Set

The data are collected from the Reserve Bank of India website and its related links. The individual websites of the public sector banks are also exploited to collect relevant data. The period covered spanned between 1998 and 2002. Due to paucity of data on the internet, analysis is done in respect of 20 public sector banks as given in Table I. We believe that analysis in respect of 20 banks would describe fairly accurately the entire profile of public sector banks in India. For the year 2002, the capital adequacy ratio cannot be obtained in respect of eleven banks.

The time horizon information measures, both for assets and liabilities, are calculated for all the referred years. Since the information measures are scale free, they are also calculated for several non-consecutive years.

The Table II shows the average information values under different capital adequacy ratio values and also the minimum and maximum values under the groups. Moreover, the capital ratios of the individual banks did not remain stable over time. The average values of information measures are calculated on period-to-period basis across switching capital adequacy ratio values. These are shown in Table III. Here, logarithm of base 10 is used to calculate expected information content. The unit of measurement is 'Hartley'. However, we would not mention it further in our study.

Summary of Results

The average information measures under each category of capital adequacy ratio, show (in Table II), different values between liabilities and assets time horizon measures. In each case, the average time horizon information measures in respect of liabilities, is always less than the average time horizon information of the assets. Even the highest and lowest values of information measure of the liabilities are systematically less than the highest and lowest information values of the assets. It shows that the assets side of the balance sheet has undergone more differential changes than the liabilities. Since, the information measure indicates variations in the items of financial statements over time, any high value would indicate higher variability, while it would show lower variability

for low value. Acting on this premise, if we now examine the behaviour of the information measure, we could isolate a trend. For instance, the average value of assets information measures for capital adequacy ratio of 7+ is 95.88×10^{-4} (henceforth the multiplier 10^{-4} will not be quoted), while 9+ capital adequacy ratio has an average value of 60.23. Since the banks, with 7+ capital adequacy ratio would be forced to take vigorous steps to reach the statutory minimum, there would be higher reshuffling of assets. The banks would also have to reallocate their liabilities in order to reach the normative minimum capital ratio. These efforts would obviously lead to greater variability amongst the various items of assets and liabilities over time and the effect of such variability would be captured in the information measure value. The veracity of the argument could be readily found when we calculate time horizon liabilities information measure. The average value of liabilities information measure for capital adequacy ratio (CAR) 7+ is 32.78, and thus supports our arguments. If we move on to examine behaviour of information values for other capital adequacy ratios, we find the average value of 77.51 for CAR 10+ and 37.60 for CAR 11+. The reason for this difference is not difficult to comprehend. In case of CAR with magnitude 10+, the banks are very near to regulatory minimum level and they would more likely to reorganise their assets and liabilities vigorously, to stay above the stipulated minimum. If such an effort were exerted, it would increase variability of the items in assets and liabilities of the banks, which would finally result in higher information value.

It may be further observed that, in both the liabilities and assets information measures, the average values for CAR 10+, are higher than those of category 9+ CAR. The

question that arises at this stage, why the average value of information measures would be higher for 10+ CAR instead of 9+ CAR, since the banks with 9+ CAR would be more pro-active to increase the capital adequacy ratio. When we examine the individual information measures of the banks having 10+ CAR, the extreme assets information value is found to be 848.44, which is included in the calculation of the average. If this extreme value is excluded from the samples, the average information value of the assets reduces to 32.16 and it fits well into our above hypothesis. In other words, banks having CAR of 9+ are in fact reorganising their total assets more actively than the banks with CAR 10+. Further, we find that the assets information measures of banks with CAR 11+ and CAR 12+ have values of 37.60 and 81.82 respectively. These values are consistent, since the banks having CAR 11+ is reasonably well placed and the banks with the same CAR would like to stay stable at the same level. The banks with CAR of 12+ are once again growth-oriented banks, as they would concentrate more on to achieve optimal position.(This is not to suggest that CAR 12+ represents the optimal position. Further research in this regard is necessary.) Having reached this position, the banks would find little incentive to reorganise their total assets in a different manner and hence the information values would be low for the banks with CAR more than 12+. Exactly the same behaviour is observed for the information measures of the banks with CAR 13+. The average value of assets information measure is 22.81, which is the lowest amongst all the average values of information measures under different capital adequacy ratios.

However, when the difference between the values of above information measures is examined, it reveals that there is hardly any planned action that induces the change in the

capital adequacy ratio values. For instance, the difference between the assets information measures of CAR 12+ and CAR 13+ is approximately equal to the difference of the average values of the assets measure of CAR 7+ and CAR 11+. Similar identical differences could be found between CAR 9+ and CAR 13+ with that of CAR 10+ and CAR 11+. Moreover when we look at the minimum and maximum values of assets and liabilities information measures under different values of capital adequacy ratios, it is observed that such minimum and maximum values behave more or less in a random manner. It is, therefore, evident that the managerial actions to counter pressure of regulatory system are of unplanned in nature. Any planned action would have affected all the banks in the same way and effect of such actions would likely to have been same on all the banks leading to near identical information values. Wide divergence shows that no such planned action was taken by majority of the banks and the observed reorganisations of assets and liabilities of the individual banks were due to routine and sometimes unplanned management policy decisions.

It would be now of interest to examine, how the information measures behave when capital adequacy ratio changes over time. An examination of the average values of information measures in Table-III reveals, that the average values of the information measures are relatively higher when the capital adequacy ratio switches from a value of 10+ to 11+, with respect to average information values when the CAR hovers within 10+ region. The higher value shows that the banks exerted additional reorganisation effort to push the capital adequacy ratio to a higher level. This is consistent to our earlier findings that banks did reorganise their assets and liabilities to change their capital ratios. Here

also, we find that the average value of liabilities measures is lower than the average value of assets measures, signifying thereby, that the banks resorted to higher reorganisation of assets rather than capital and liabilities. The highest information value is seen in case of CAR switching values from 10+ to 12+, followed by CAR switching from 11+ to 12+. Since, additional effort would be required to push CAR to a magnitude of 12+, it shows near equal highest information values for both the above cases. In contrast, less effort is required to push the CAR from 12+ to 13+ and accordingly the information value is less in this case. However, behaviour of the measures for other switching values of the CAR cannot be explained with the above argument. The information values for CAR switching from 11+ to 13+ are 13.50 for liabilities and 36.09 for the assets, while CAR moving within 11+ range have nearly identical values, viz., 13.46 for liabilities and 31.60 for assets. It shows that banks hardly took any planned step to reorganise its assets and liabilities for the switching of the CAR. This phenomenon therefore suggests that, switching to higher value of CAR is possible without any planned managerial policy of reorganisation. The above findings are further supported when we examine the behaviour of information measures in a downward movement of CAR. The variability of the average values of liabilities measures cannot be explained by the above hypothesis for downward movement of CAR from 13+ to 12+ and from 11+ to 10+. The behaviour of measures for the CAR switching from 11+ to 7+ cannot be explained when compared against CAR switching from 12+ to 11+. It points to a clear possibility that banks although significantly changed their assets portfolio for adjustment of the CAR, but such efforts were not induced or planned but largely dependent on the perfunctory banking activities.

It is therefore observed that the information analysis is capable of explaining the behaviour of the banks in capital adequacy system regime. We find larger value of information measure when the capital adequacy ratio value is 12+. Such a large value shows that the banks reorganise their assets strongly at this level. Beyond this level, there is little incentive to change their status and the evidences in this regard are captured in information analysis. However, the minimum and maximum information values describe some random characteristics and hence it is inferred that the banks do not resort to planned action to influence their capital adequacy structures. This view is further supported by the evidence of random behaviour of characteristic differences between information measures under different group of capital adequacy ratios. We also find that asset information measures are higher than the liabilities information measures, evidencing higher reorganisation of assets compared to capital and liabilities. Further evidences of random behaviour of information measures in upward and downward switching movements of CAR, strongly point out that the banks are not induced or forced to take planned steps to attain targeted value of the capital adequacy ratio.

Conclusion

In India, capital standards for the banks have been introduced, in line with international practices, since 1992. Although a decade has passed, there are few researches in this direction to find out how banks adjust their normative capital ratios under the regulatory system. The purpose of the present study is to find out management behaviour with

respect to their capital adequacy ratio dynamics, by decomposing the financial statements. We use information analysis of the balance sheet and a data set that spanned between 1998 and 2002, for twenty public sector banks.

We find that information measures can explain banks' policy decisions on liabilities and assets reorganisation. Quantitatively, we find that proportional development took place, in both liabilities and asset items of the banks under different capital adequacy ratio values. Evidences show that banks have reorganised their assets and liabilities to achieve higher capital adequacy ratios, but the evidences also point out such reorganisation do not result from a planned action of the banks, except in certain isolated cases. We have also found that the assets reorganisation is more pronounced than the reorganisation of the liabilities. In other words, banks have resorted to reshuffling their assets differentially more than the proportional reorganisation of their capital and liabilities, during the referred period. The behaviour of both assets and liabilities information measures, is found to be largely random during investigation of period-to-period switching capital adequacy ratio values. It indicates that except in certain isolated cases, majority of the banks do not take deliberate steps to attain higher capital adequacy ratio.

The study also points out that since there is little change in information measures of the banks at higher capital adequacy ratio level, the Reserve Bank of India is justified in enhancing the normative minimum CAR from 8% to 9% effective from the year 2000. This study foresees that there will not be any added difficulty if the capital adequacy ratio is raised further to 10% in near future.

TABLE I

NAME OF SAMPLE BANKS

1	Central Bank of India*
2	Bank of Maharashtra*
3	Syndicate Bank
4	Oriental Bank of Commerce*
5	Vijaya Bank
6	Dena Bank
7	Andhra Bank
8	Bank of Baroda
9	Bank of India
10	Corporation Bank*
11	Punjab National Bank*
12	Union Bank of India
13	Canara Bank
14	Allahabad Bank*
15	State Bank of India
16	State Bank of Patiala*
17	State Bank of Hyderabad*
18	State Bank of Mysore*
19	State Bank of Indore*
20	State Bank Of Travancore*

* Capital Adequacy Ratio for 2002 not available for these Banks.

TABLE II

AVERAGE INFORMATION VALUES UNDER DIFFERENT CAPITAL ADEQUACY RATIOS

CAPITAL ADEQUACY RATIO	Average Information Value		Minimum Value		Maximum Value	
	LIABILITIES	ASSETS	LIABILITIES	ASSETS	LIABILITIES	ASSETS
7 or more but less than 8	32.78	95.88	5.8	55.1	59.75	136.66
9 or more but less than 10	2.13	60.23	1.73	19.64	2.53	143.21
10 or more but less than 11	16.51	77.51	1.47	3.67	93.39	848.44
11 or more but less than 12	22.54	37.6	2.98	2.26	96.64	203.26
12 or more but less than 13	24.31	81.82	1.19	8	67.52	296.58
13 or more but less than 14	9.38	22.81	0.95	9.85	16.78	33.3

- All the above values are expressed as : x 10^{-4} Hartley

TABLE III

AVERAGE INFORMATION VALUE
and
SWITCHING CAPITAL ADEQUACY RATIOS

Capital Adequacy Ratio Switching Value		Average Value of Information Measure	
FROM	**TO**	**LIABILITIES**	**ASSETS**
upwards		(x 10-4 Hartley)	
10+	10+	13.41	32.59
10+	11+	17.94	61.22
10+	12+	17.33	100.38
11+	11+	13.46	31.6
11+	12+	11.51	99.3
11+	13+	13.5	36.09
12+	13+	13.77	57.43
downwards			
13+	12+	6.79	39.62
12+	11+	30.17	41.68
11+	10+	4.76	304.32
11+	7+	54.89	96.61

APPENDIX A

Syndicate Bank					
	Mar 02	**Fraction / Probabilility**	**Mar 01**	**Fraction / Probabilility**	**INFORMATION VALUE**
CAPITAL AND LIABILITIES	Rupees in Crores	q_i	Rupees in Crores	p_i	$q_i \log q_i/p_i$
Capital	471.95	0.014861674	471.94	0.016709857	-0.00075653
Reserves and Surplus	938.44	0.029551413	746.7	0.026438213	0.001428697
Deposits	28548.33	0.898985016	25094.84	0.888526481	0.004568712
Borrowings	36.65	0.001154106	216.47	0.007664497	-0.00094895
Other Liabilities & Provisions	1760.81	0.05544779	1713.26	0.060660952	-0.00216385
TOTAL	**31756.18**	1	**28243.21**	1	0.002128077
ASSETS					
Cash & Balances with RBI	1972.03	0.062099094	1957.69	0.069315421	-0.0029649
Balances with Banks & money at Call etc.,	1170.93	0.036872508	1058.38	0.037473786	-0.00025903
Investments	11910.6	0.375064003	10550.09	0.373544296	0.000661341
Advances	14884.66	0.468716955	13116.16	0.46440047	0.001883311
Fixed Assets	338.99	0.010674773	321.64	0.011388224	-0.00029993
Other Assets	1478.97	0.046572667	1239.25	0.043877803	0.001205591
TOTAL	**31756.18**	1	**28243.21**	1	0.000226388

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