CANONICAL CORRELATION ANALYSIS OF ASSET-LIABILITY MANAGEMENT OF INDIAN BANKS

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Introduction

Bank asset-liability management (ALM) may be defined as the simultaneous planning of all asset and liability positions on the bank's balance sheet under consideration of the different bank management objectives and legal, managerial and market constraints, for the purpose of enhancing the value of the bank, providing liquidity, and mitigating interest rate risk (Gup and Brooks, 1993). An efficient asset-liability management system aims to manage the volume, mix, maturity, rate sensitivity, quality and liquidity of the assets and liabilities as a whole, so as to earn a predetermined, acceptable risk/reward ratio.

The framework of asset-liability management broadly covers area of interest rate risk, liquidity risk, exchange risk and credit risk. ALM can be defined as an operation for assessing the above mentioned risks, actively altering the asset-liability portfolio, and for strategically taking actions and managing risks with the objective of maximizing profits .ALM is not limited to on balance sheet assets and liabilities such as deposits and lending's only, but also includes off –balance sheet activities such as swaps, futures and options. The objective of ALM is to make banks fully prepared to face the emerging challenges.

Literature Review

There is a considerable literature addressing asset-liability management in banks. One of the key motivators of asset-liability management worldwide was the Basel Committee. The Basel Committee on Banking Supervision (2001) formulated broad supervisory standards and guidelines and recommended statements of best practice in banking supervision. The purpose of the committee was to encourage global convergence toward common approaches and standards. In particular, the Basel II norms (2004) were proposed as an international standard for the amount of capital that banks need to set aside to guard against the types financial and operational risks they face. Basel II (2004) proposed setting up rigorous risk and capital management requirements designed to ensure that a bank holds capital reserves appropriate to the risk the bank exposes itself to through its lending and investment practices. Generally speaking, these rules mean that the greater risk to which the bank is exposed, the greater the amount of capital the bank needs to hold to safeguard its solvency and overall economic stability. This would ultimately help protect the international financial system from the types of problems that might arise should a major bank or a series of banks collapse.

Haslem et al. (1999) used canonical analysis and the interpretive framework of asset/liability management in order to identify and interpret the foreign and domestic balance sheet strategies of large U.S. banks in the context of the "crisis in lending to

LDCs." Their study found that the least profitable very large banks have the largest proportions of foreign loans, yet they emphasize domestic balance sheet (asset/liability) matching strategies. Conversely, the most profitable very large banks have the smallest proportions of foreign loans, but, nonetheless, they emphasize foreign balance sheet matching strategies.

Vaidyanathan (1999) discussed issues in asset-liability management and elaborates on various categories of risk that require to be managed in the Indian context. Vaidyanathan (1999) argued that the problem gets accentuated in the context of change in the main liability structure of the banks, namely the maturity period for term deposits. For instance, in 1986, nearly 50% of term deposits had a maturity period of more than five years and only 20%, less than two years for all commercial banks, while in 1992, only 17% of term deposits were more than five years whereas 38% were less than two years. He found that several banks had inadequate and inefficient management systems. He also suggested that, as bank profitability focus has increased over the years, there is an increasing possibility that the risk arising out of exposure to interest rate volatility would be built into the capital adequacy norms specified by the regulatory authorities, thus in turn requiring efficient asset-liability management practices.

Vaidya and Shahi (2001) studied asset-liability management in Indian banks. They suggested in particular that interest rate risk and liquidity risk are two key inputs in business planning process of banks.

Ranjan and Nallari (2004) used canonical analysis to examine asset-liability management in Indian banks in the period 1992-2004. They found that SBI and associates had the best asset-liability management in the period 1992-2004. They also found that, other than foreign banks, all other banks could be said to be liability-managed; i.e. they all borrowed from the money market to meet their maturing obligations. Private sector banks were found to be aggressive in profit generation, while nationalized banks were found to be excessively concerned about liquidity.

The present study analyses asset-liability management in Indian banks using the methodology of Ranjan and Nallari (2004). The study covers all scheduled commercial banks except regional rural banks (RRBs), in the five-year period 2003-08. The banks are grouped on the basis of ownership structure: viz. public sector banks (including SBI & associates), private sector banks, and foreign banks.

Data and Methodology

The data for the present study consists of the assets and liabilities (from the balance sheets) of a sample of fifty-one banks with India-wide operations in the study period 2003-08 from the Capitaline database (www.capitaline.com). The sample banks included twenty-seven public sector banks, fourteen private sector banks, and ten foreign banks.

The study uses canonical correlation analysis to assess the nature of asset-liability management of different bank groups, as described in Ranjan and Nallari (2004). To this end, the assets and liabilities of the banks were first reclassified as discussed below. The canonical correlation technique was applied to these reclassified assets and liabilities. The results of the canonical correlation analysis were then interpreted in terms of their implications on profitability, liquidity, and interest rate sensitivity.

Following Ranjan and Nallari (2004), the assets and the liabilities of the banks were regrouped into various sub-heads, guided by the liquidity-return profile of the assets and the maturity-cost profile of the liabilities. The reclassified assets and liabilities covered in the study excluded 'other assets' on the asset side and 'other liabilities' on the liabilities side. This was necessary to deal with the problem of singularity - a situation that produces perfect correlation within sets and makes correlation between sets meaningless. The assets of a bank were regrouped into five major heads: liquid assets (LA), SLR securities (SLR), investments (I), advances (A), and fixed assets (FA). Liquid assets consist of cash in hand, balances with RBI, balances with other banks, and money at call and short notice; these assets are typically characterized by high liquidity and low returns. SLR securities consist of government securities and other approved securities; they are characterized by high liquidity and medium returns. Investments consist of securities other than SLR such as shares, debentures, bonds, subsidiaries and others; they are characterized by medium liquidity and medium returns. Advances consist of term loans, as well as short-term loans, i.e. bills purchased and discounted, cash credits, overdrafts and loans; these are typically characterized by high to medium liquidity (depending on maturity) and high returns. Finally, fixed assets consist of the fixed assets per se, and are characterized by low liquidity and low returns.

The liabilities of a bank were divided into three major heads; net worth (NW), deposits (D), and borrowings (B). Net worth consists of capital and reserves and surpluses; these liabilities are typically characterized by long maturity and low cost. Deposits consist of demand deposits, savings bank deposits, and term deposits; they are characterized on the one hand by low maturity and low cost (for short-term deposits) and on the other by medium maturity and high cost (for long-term deposits). Borrowings consist of borrowings from RBI, borrowings from other banks, and borrowings from other financial institutions, both from India and abroad; they are characterized by low maturity and medium cost.

Canonical correlation is a multivariate statistical technique that has been used to assess the nature and strength of relationship between the assets and liabilities. The correlation between each set of assets and each set of liabilities indicates the relationship between assets and liabilities, but all of these correlations assess the same hypothesis - that assets influence liabilities. Canonical correlation provides a means to explore all of the correlations concurrently. The technique reduces the relationship into a few significant relationships. The essence of canonical correlation measures the strength of relationship between two sets of variables (assets & liabilities in this case) by establishing linear combination of variables in one set and linear combination of variables in other set. It produces an output that shows the strength of relationship between two variates as well as individual variables accounting for variance in the other set. This is expressed mathematically as:

$$A = A_1 * LA + A_2 * SLR + A_3 * I + A_4 * A + A_5 * FA \quad (1)$$

$$\text{and } L = L_1 * NW + L_2 * D + L_3 * B. \quad (2)$$

To begin with, A and L (called canonical variates) are unknown. The technique tries to compute the values of A_i and L_i such that the correlation between A and L is maximized. In the present study, canonical correlation was performed with the additional restrictions that the canonical weights were between -1 and +1.

Table 1. Canonical Correlation Analysis of Assets and Liabilities of Banks

	2003-04			2004-05			2005-06			2006-07			2007-08			Overall (2003-08)		
	Foreign Banks	Private Banks	Public Banks	Foreign Banks	Private Banks	Public Banks	Foreign Banks	Private Banks	Public Banks	Foreign Banks	Private Banks	Public Banks	Foreign Banks	Private Banks	Public Banks	Foreign Banks	Private Banks	Public Banks
Squared Canonical Correlation (R^2)	0.99996	0.99990	0.99991	0.99998	0.99999	0.99994	0.99998	0.99999	0.99996	0.99999	0.99998	0.99995	0.99998	1.00000	0.99996	0.99998	0.99997	0.99994
Canonical Loadings: ASSETS																		
Liquid Assets	0.092	0.789	0.112	0.077	0.321	0.171	0.098	0.016	0.129	0.113	0.274	0.183	0.136	0.227	0.172	0.103	0.326	0.154
SLR Securities	0.076	0.267	0.094	0.065	0.102	0.102	0.102	0.336	0.100	0.134	0.217	0.132	0.325	0.201	0.165	0.140	0.225	0.119
Investments	0.199	0.245	0.165	0.250	0.143	0.107	0.187	0.674	0.180	0.139	0.402	0.250	0.328	0.195	0.198	0.221	0.332	0.180
Advances	0.086	0.786	0.121	0.105	0.135	0.117	0.128	0.974	0.120	0.108	0.590	0.163	0.251	0.434	0.188	0.136	0.584	0.142
Fixed Assets	0.547	-1.087	0.508	0.502	0.298	0.502	0.485	-1.000	0.471	0.505	-0.484	0.272	-0.040	-0.057	0.278	0.400	-0.466	0.406
Canonical Loadings: LIABILITIES																		
Net Worth	0.133	0.276	0.334	0.127	0.554	0.419	0.245	0.561	0.208	0.296	0.588	0.260	0.304	0.361	0.380	0.221	0.468	0.320
Deposits	0.501	0.373	0.311	0.553	0.225	0.283	0.410	0.198	0.375	0.344	0.216	0.347	0.256	0.289	0.303	0.413	0.260	0.324
Borrowings	0.366	0.351	0.355	0.321	0.220	0.299	0.345	0.241	0.417	0.360	0.196	0.392	0.440	0.351	0.318	0.366	0.272	0.356
Redundancy																		
Assets (A)	0.072	0.511	0.064	0.067	0.048	0.063	0.061	0.503	0.059	0.063	0.173	0.043	0.059	0.064	0.042	0.065	0.260	0.054
Liabilities (L)	0.134	0.113	0.111	0.141	0.136	0.115	0.116	0.137	0.119	0.112	0.144	0.114	0.117	0.037	0.112	0.124	0.113	0.114
Independent Set	A	L	A	A	A	A	A	L	A	A	L	A	A	L	A	A	L	A
Dependent Set	L	A	L	L	L	L	L	A	L	L	A	L	L	A	L	L	A	L

Analysis and Interpretation

The results of the canonical correlation analysis are presented in Table 1. The first row (R^2) is a measure of the significance of the canonical correlation. All the canonical correlations were found to be significant. The canonical loading is a measure of the strength of the association, i.e. it is the percent of variance linearly shared by an original variable with one of the canonical variates; a loading greater that 40% is taken to be significant. A negative loading indicates an inverse relationship.

For example, for foreign banks the fixed assets (FA) under assets has a loading of 0.547 and deposits (D) under liabilities has a loading of 0.501. Since both are positive this means there is a strong correlation between fixed assets and deposits. Similarly for private banks, there is a strong negative correlation between fixed assets and deposits.

Redundancy factors indicate how redundant one set of variables is, given the other set of variable which gives an idea about independent and dependent sets. This also gives an idea about the fact that whether the bank is asset managed or liability managed.

As presented in Table 1, the canonical correlation coefficients of different set of banks indicate that different banks have different degree of association among constituents of assets and liabilities. The bank groups can be arranged in overall decreasing order of correlation: foreign banks, followed by private banks, and lastly public banks.

Looking at the redundancy factors, the independent and dependent sets for different bank groups can be identified: foreign and public banks have assets as their independent set, which means that during the period 2004-2008, these banks were actively managing assets and liability was dependent upon how well the assets are managed; on the other hand, for private banks, liabilities were the independent set.

For foreign banks, fixed assets from the assets side and deposits (and to some extent borrowings) from liabilities side have significant presence in the canonical loadings. Thus, there is strong correlation between fixed asset and deposits, indicating proper usage of fixed assets and deposits in asset-liability management. However, this could indicate possible liquidity issues, as well as interest rate sensitivity, as fixed assets are of low liquidity and are interest-rate-neutral, while deposits and borrowings include relatively liquid short-term deposits and tend to be interest-rate sensitive. Foreign banks have assets as their independent set. This means that during the study period (2004-2008), these banks were actively managing assets, and liabilities management was dependent upon how well the assets were managed.

For private banks, liquid assets, investments, advances, and fixed assets from the assets side and net worth, deposits, and borrowings from the liabilities side have significant presence in the canonical loadings. Thus, there is strong positive correlation between liquid assets, investments, and advances on the one hand and net worth, deposits, and borrowings on the other; and strong negative correlation between fixed assets and net worth, deposits, and borrowings. This shows that private banks actively manage their assets and liabilities to generate maximum return. In terms of liquidity and interest rate risk, this would indicate a proper balance. Private banks have liabilities as their independent set, which means that during the study period (2004-2008), these banks were actively managing liabilities, and assets management was dependent upon how well the liabilities were managed.

For public banks, fixed assets from the assets side and net worth, deposits, and borrowings from the liabilities side have significant presence in the canonical loadings. The increasing contribution of investments and advances and loans perhaps indicates that liquidity and profitability of public banks have been improving in recent years. However, this could indicate possible liquidity issues, as well as interest rate sensitivity, as fixed assets are of low liquidity and are interest-rate-neutral, while deposits and borrowings include relatively liquid short-term deposits and tend to be interest-rate sensitive. Public banks have asset as their independent set, which means that during the study period (2004-2008), these banks were actively managing assets, and liabilities management was dependent upon how well the assets were managed.

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Abstract

Asset-liability management is the simultaneous planning of all asset and liability positions for a bank, considering the different bank management objectives and the legal, managerial and market constraints, for the purpose of enhancing the value of the bank, providing liquidity, and mitigating interest rate risk. The framework of asset-liability management broadly covers the areas of interest rate risk, liquidity risk, exchange risk and credit risk. The present study uses canonical correlation analysis to assess the nature of asset-liability management of different bank groups. The results of the study indicate that, among the three groups, private banks had the most dynamic asset-liability management, with a strategy of active liability management. Public and foreign banks seemed to concentrate on fixed assets in their asset-liability management strategies, without actively involving other asset classes, thus bringing the possibility of liquidity and interest rate sensitivity issues in their asset-liability management.

Keywords: asset-liability management, canonical correlation, profitability, liquidity, interest rate sensitivity