ALM IN BANKS

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ABSTRACT

Assets and liabilities management practices currently in use are reviewed. Some of the improvements currently under development are presented. Potential problems in the application of current ALM techniques to universal banks are considered.

1. INTRODUCTION

Assets and liabilities management (ALM) has evolved over the last twenty years in response to the growth of financial markets and the availability of new analytic tools and information systems. The unpredictable path of financial innovation has shaped the development of ALM and poses new challenges for the evolution of current systems. These challenges are not only technical, but also organizational. Successful financial institutions need to retain operational flexibility in spite of an ever increasing number of regulatory constraints. This target is especially problematic to achieve for institutions rooted in traditions different from the ones from which current ALM techniques originated.

The classic approach to ALM in North America is presented in Section 2. The evolution of ALM and some problems posed by the necessity to fit derivative securities in existing ALM systems are discussed in Section 3. Potential difficulties in applying current ALM to universal banks are examined in Section 4. A brief summary concludes the paper.

2. CURRENT ALM PRACTICES

The aim of ALM is to protect margins of profitability from negative surprises in market prices or credit risks. To achieve that, it is necessary to have up to date information on exposures to different sources of risk and appropriate tools to correct possible unbalances.

Gap Analysis.

It is generally acknowledged that the balance sheet of a financial institution should be neutral with respect to interest rate moves, because it is not well suited to take advantage of short term market trends. The basic

ALM technique that verifies the duration matching of assets and liabilities is gap analysis.

Duration is defined as the weighted average of times t_i's at which cash flow occur, with weights given by the present values of the amounts to be exchanged, CF_i's:

$$d = \frac{\Sigma t_i PV\left(CF_i\right)}{\Sigma PV\left(CF_i\right)} \qquad (1)$$

Assets and maturities are divided in several windows (usually 8 or 10) according to their duration and the present values of assets and liabilities in each window are compared. The gap between the present values of assets and liabilities provides not only a measure of the institution's exposure to interest rate risk, but also an indication of future liquidity needs, although the maturity gap is more commonly used for this purpose (Shaffer, 1991). In the maturity gap only principal payments are considered, sorted according to their repricing intervals.

The aim of gap analysis is to attempt to offset gains or losses in assets due to changes in interest rates with opposite changes in liabilities. Because assets and liabilities are matched by either duration or maturity in gap analysis, they may present different time profiles of cash flows. Therefore the performance of the gap model may be negatively affected by non-parallel shifts in the term structure of interest rates, the neglect of credit risk or natural hedges in the operation of financial firms.

Duration models assume small parallel shifts in the term structure to estimate the sensitivity of prices of fixed income claims to changes in interest rates. They ignore the possibility of non-parallel shifts or the convexity of assets and liabilities. The impact of non-parallel shifts may be estimated by evaluating the impact of a small rotation in the term structure

(twist), while convexity is defined by

$$\text{Convexity} = \frac{1}{2}\frac{\partial^2 P}{\partial y^2}\frac{1}{P} \tag{2}$$

where P is the market value of a security and y is its market yield. Convexity increases with the level of interest rates and is inversely related to coupons. A financial intermediary with a positive coupon spread on a zero net present value portfolio is subject to negative convexity (Fabozzi and Fabozzi, 1989), leading to additional losses in value for discrete changes in interest rates.

In the presence of credit risk gap analysis cannot match liabilities with an uncertain income stream. Of course this problem is more severe for more doubtful claims. Some banks try to adjust for credit risk by marking down the amounts of assets to be hedged, but this adjustment can only reflect expectations at the time it is made and may increase the potential for balance sheet manipulation (Pozdena, 1990).

Moreover, financial institutions may have some natural interest rate hedges which are not apparent in gap analysis. As an example, lower interest rates may accompany a slowdown of economic activity, which may affect margins or credit risk as well as the volume of new business. Some financial institutions already try to compensate for these effects with appropriate hedges (Loomis, 1994).

The above considerations and the growing importance of assets and liabilities subject to risks other than changes in domestic interest rates brought an increasing number of financial institutions to consider a portfolio approach in the implementation of their ALM systems. The portfolio approach is also necessary to manage the risk of the bank's own portfolio. In fact hedging the bank's proprietary investing and trading would simply undo the

bank's results.

The portfolio approach

Modern financial theory suggests that assets and liabilities can be viewed as components of a portfolio, to which optimization techniques pioneered by Markowitz (1959) can be applied. These techniques aim at minimizing the variance of portfolio return at any given level of expected return or maximizing expected return at any given level of variance. The choice of the acceptable level of variance is left to management.

The portfolio approach was originally intended to help manage price risk only, taking into account the covariances between different assets and liabilities' returns. The necessity of including credit risks, operational risks and liquidity risks in the ALM system, the necessity of considering non-traded claims and the desire to integrate the analysis of profitability for individual operations has led to numerous extensions of the portfolio approach over time. Regulatory capital requirements introduce additional constraints. A modern ALM system ideally monitors risk, allocates capital and verifies the profitability of individual operations.

Monitoring

To monitor risk in its different dimensions it is necessary to keep multiple sets of electronic books to which information is provided infradaily. Summaries are provided at the end of the day. Continuous monitoring is necessary not only to evaluate compliance with stated policies, but also for early identification of unexpected sources of risk, such as abnormal widening of the basis between hedging instruments and underlying assets, which has led to major losses in the case of Metallgesellschaft (Loomis, 1994). To prevent

similar disasters it is important that ALM committees meet often and include senior managers.

The monitoring system needs to provide profiles of bank exposure to credit, interest rate and liquidity risk. This can be achieved by mapping cash flows by counterparty, duration and time. The first map reports net present values receivable from different counterparties and allows for the estimation of different scenarios of default. The second map estimates interest rate risk, though usually this analysis is limited to parallel shifts in the term structure, which are not adequate to measure the price risk of most contingent claims. The third map measures liquidity and impact of different interest rate and default scenarios on it. Useful indicators are concentration ratios[1] in the first map (Levonian, 1990), daily earnings at risk and value at risk[2] (J.P. Morgan, 1994) in the second map and gap analysis of cash flows (Houpt and Embersit, 1991) in the third map.

Capital Allocation

The allocation of capital to maximize profitability according to Markowitz's model privileges areas of operations with higher expected return on employed capital and penalizes areas with high covariances with the overall results of the bank. To estimate expected returns on employed capital it is

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[1]Concentration ratios of credit by industry and loan size are useful predictors of bank crises.

[2]Daily earnings at risk (DEAR) are the standard deviation of daily results. For new claims they can be computed as the product of the dollar value due to a change of one basis point in interest rates times the potential adverse move in basis point. The potential adverse move in rates is defined as the adverse daily move which is exceeded statistically only once a month. This definition needs to be often verified because of changing market volatility. Value at risk equals daily earnings at risk times the square root of the closeout period. Often closeout is limited to ninety days.

necessary to estimate expected dollar returns from historical experience or other sources and to define employed capital. It is often not obvious how much capital is absorbed by operations with uncertain results. Newer approaches to this problem will be discussed in Section 3. The present discussion will be limited to current practices.

Currently capital allocation is based on diversification and performance evaluation. To evaluate the benefits of diversification it is necessary to identify the correlation matrix of assets and liabilities. This task is complicated by the occurrence of unstable correlations, a problem especially acute in some arbitrage trades. Moreover the benefits of capital allocation in controlling overall risk may be illusory when different units change rapidly the size and composition of their portfolios. These problems are more severe for actively trading institutions without core assets or liabilities.

International regulators mandate capital requirements for credit and market risk, such as the ones contained in the BIS agreement (1986). Most countries have developed their own requirements within this framework. These requirements are seen by financial institutions as constraints on their operations (Brunner et al., 1991). Therefore it is tempting to use these capital requirements as measures of capital absorption in allocating capital within the bank. The shortcoming of this commonly used approach is that regulators are concerned with banks' survival in mandating capital requirements, not their profitability.

The rationale for current capital requirements is that historically banks have failed because of loan defaults, not because of movements in interest

rates.[3] Therefore regulators require very large amounts of capital to offset credit risk and only relatively smaller amounts to offset interest rate risk, even though interest rate risk affects bank profitability in a significant way and may become a more frequent cause of bank failure in the continuing evolution of the banking business (Houpt and Embersit, 1991). Moreover capital requirements are not adjusted for the concentration or diversification of banks' assets. It follows that allocating capital on the basis of capital requirements is suboptimal in general, though any superior allocation needs to satisfy capital requirements.

Profitability

Ideally, the ALM system should also provide assessments of performance that go beyond the measurement of total revenue by taking into account risk and capital commitments. To achieve this it is necessary to introduce performance measures, which evaluate profitability from different angles.

The investment perspective leads to adjusting total revenue by actual volatility, the Sharpe ratio. The risk perspective adjust total revenue by its expected volatility (DEAR), where expectations are usually based on the past history of security returns. This is the risk ratio. Finally, the efficiency ratio takes the ratio of the risk ratio over the Sharpe ratio, measuring traders' ability to time market volatility.

The Sharpe ratio may be regarded as a measure of overall performance, the risk ratio as a measure of selectivity, the efficiency ratio as a measure of risk timing ability. Selectivity is defined as the ability to choose better

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[3] An exception is the failure of Swedish banks in the 1992 EMV crisis, which brought the Swedish short term rates to 500%. See also Woolley (1994).

securities at a given level of risk timing as the ability to outguess the market prediction of volatility. The three measures are related by the relationship

$$\begin{array}{lll} \text{Sharpe ratio} & = \text{risk ratio} \div \text{efficiency ratio} & (3) \\ \text{(overall performance)} & = \text{(selectivity)} \div \text{(timing)} & \end{array}$$

These commonly used performance ratios are not adjusted for their contribution to the overall risk of the bank, because they contain no information on correlations with other units.

3. NEW DEVELOPMENTS IN ALM

The ALM framework presented in Section 2 is in the process of being reshaped, mostly because of the operational and regulatory needs originating with the growth of derivative markets. It will be convenient to segment new developments in the three functional areas used above: monitoring, capital allocation and performance evaluation.

Monitoring

The traditional approach to monitoring looks at earnings' volatility generated by a given change in domestic interest rates. This approach is not satisfactory, for evaluating the riskiness of claims which depend on foreign interest rates, exchange rates, security or commodity prices or changes in the shape of the term structure. Moreover the sensitivities of prices to changes in these variables cannot be regarded as constants for many derivative securities. Options are typical examples of that, with several models employed in the estimation of sensitivities. Once the appropriate sensitivities are estimated, it is reasonable to define daily earnings at risk as

$$DEAR = \sqrt{\sum_{i=1}^{N} \Delta_i \Delta_j \sigma_{ij}}, \qquad (4)$$

where N is the number of "important" variables underlying the position, Δ_i represents the delta of the position with respect to variable i, that is the ratio of the change in the value of the position with respect to a small change in the level of the variable i and σ_{ij} is the covariance of the changes in variable i with changes in variable j. Individual securities sensitivities with respect to the same variable can be added up to evaluate the sensitivity of a portfolio. Because of the variability of deltas with prices, time and market conditions, it is useful to estimate also the gamma, theta, rho and vega of each position. Gamma measures the sensitivity of delta to changes in the underlying security price, $\frac{\partial \Delta}{\partial x} = \frac{\partial^2 y}{\partial x^2}$, theta is the time sensitivity, $\frac{\partial y}{\partial t}$, rho is the interest rate sensitivity, $\frac{\partial y}{\partial r}$, vega is the sensitivity to volatility changes, $\frac{\partial y}{\partial \sigma}$.

It is often convenient to focus on sensitivities rather than DEAR because sensitivities evidence the riskness of securities with respect to each source of price risk. Moreover the variability of deltas makes DEAR unrelated to the total earnings at risk over time horizons longer than a day. This problem may be overcome by decomposing each security in a series of forward contracts and running a simulation under different sets of assumptions for the evolution of the underlying state variables.

Capital Allocation

Capital allocation must satisfy regulatory requirements while ensuring efficient use of the firm's risk capital and control of the overall risk. These conflicting targets suggest different definitions of risk capital: capital required by regulators, capital required to buy a third-party

insurance contract, such as a put option, or the contribution of a given security to DEAR.

A reasonable approach is to maximize market value subject to constraints imposed by regulatory requirements and overall risk. This mathematical programming model may be extended to include constraints on other dimensions, such as liquidity or credit risk. With regard to credit risk, securities for which third party insurance is not available or is too expensive, as is the case with swaps, may be assessed using the expected loss approach (Wall and Pringle, 1988).

Performance Evaluation

The great differences in leverage implicit in many derivative securities suggest that allowances be made for risk in performance evaluation. The variable riskness of instruments like options or swaps suggests that this adjustment be based on analytic models rather than historical experience.

The simplest analytic model, RAROC (risk adjusted return on capital), adjusts expected returns for risk. RAROC becomes untractable in the case of variable risk, as it occurs in options. Moreover it does not reflect directly commitment of risk capital. A possible approach to solve these difficulties is RORAC (return on risk adjusted capital), which requires return greater than the risk-free rate on an amount of capital adjusted to reflect the riskness of the investment. The amount of capital required to adjust the investment for risk reflects the notional cost to buy additional derivative contracts to make the project riskless (Merton, 1993). RORAC is still in the early stage of experimentation in some financial institutions.

4. IMPLEMENTING ALM IN UNIVERSAL BANKS

The application of current ALM techniques in the management of universal banks encounters several difficulties, especially in the areas of capital allocation and performance evaluation.

Usually capital allocation in ALM assumes mutual independence of investment decisions. This is unlikely to be the case for universal banks, which exist because of sinergies in the supply of different financial services. As an example, the onerous capital requirements associated with credit have led several of the most sophisticated North American banks to reduce their reliance on lending. However lending activity is a necessary complement in the generation of fee income from financial services, which is becoming an increasingly important source of revenue for most banks. To develop this source of revenue it may be necessary to fund loans which may not appear to be profitable in the standard ALM framework, because the demands of customers on the different services banks provide are related.

Moreover, a rapid withdrawal of banks from lending would accelerate the disintermediation process, because firms would have to compete with banks in attracting savings. Although the experiences of several countries suggest that this trend is in some measure inevitable, it is clearly not in the interest of banks to hasten the disintermediation of savings. For these reasons, excessive reliance on artificial pricing mechanisms to allocate revenues from a bundle of services provided to customers to the separate components of the bundle may be deceptive.

The issue of profitability of banking operations is complicated further by the current trend to marking assets and liabilities to market, which is based on the "perfect capital markets" paradigm. Banking is founded on information asymmetry, which allows credit officers to formulate a better

assessment of customers and therefore of loan profitability than what is available in the market place to uninformed investors. This asymmetry introduces ambiguity in the valuation of loans, a problem especially severe in the absence of a secondary market for corporate loans.

The above considerations indicate that the standard ALM framework must be modified to include new financial instruments and reflect the different development stages of the capital markets in which banks operate. The continuing evolution of these factors suggest that a pragmatic rather than a normative approach be taken, with careful consideration given to the strategic implications of ALM choices.

5. CONCLUSION

The evolution of ALM over the last twenty years has led to current practices, which are followed by most sophisticated financial institutions. The introduction of new financial contracts and the different degrees of development of capital markets pose new challenges to ALM models, which must be flexible enough to allow for the continuing evolution taking place in financial markets. In particular, the design of ALM systems for universal banks must recognize the complexity of these banks' portfolio choices in order to avoid that the introduction of new ALM systems result in undesirable strategic constraints.

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