ASSET-LIABILITY MANAGEMENT: THEORY, PRACTICE, AND THE ROLE OF JUDGMENT

by

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We have two kinds of forecasters, those who don't know and those who don't know that they don't know.

John Kenneth Galbraith

I. PURPOSE

The purpose of this paper is to analyze the manner in which asset-liability management (ALM) is currently practiced by depository institutions. ALM is the process that deals with interest rate risk (IRR) management. This process is extraordinarily important because interest rate risk is one of the two primary risks facing institutions, the other being credit risk. In addition to its role in maintaining the safety and soundness of financial institutions, the effective management of interest rate risk provides one of the main sources of institutional compensation.

In recent years interest rate risk measurement and management has taken on added importance as net interest margins have become compressed due to declining loan volume and historically low interest rates, especially on investments and variable-rate loans. Operational and regulatory costs have increased along with loan losses and politically motivated attacks on fee income. This has put added pressure on performance. The low-rate environment itself is also believed by regulators to pose a significant risk because it is feared that some institutions are now taking on excessive interest rate risk in order to offset these pressures and improve current income. Finally, over the past year federal examiners of depository institutions have issued new guidance on IRR management. Furthermore, the National Credit Union Administration (NCUA), the regulator of federally-insured credit unions, will be releasing a new IRR management regulation. This raises the stakes for credit unions.

The first step in the risk management process is the measurement of this risk. This is a delicate balancing act. If a high-risk situation is incorrectly assessed as low-risk, its safety and soundness could be in jeopardy; if a low-risk situation is incorrectly assessed as high-risk, it may reduce a safe and acceptable risk profile to a less productive level thus reducing its income potential and its ability to function effectively as a financial intermediary. Before examining the risk measurement issue in detail, it is useful to review the root cause of the interest rate risk management issue—the Savings & Loan (S&L) crisis of the 1980s and its aftermath.

II. OVERVIEW OF THE IRR PROBLEM

A. The S&L Syndrome

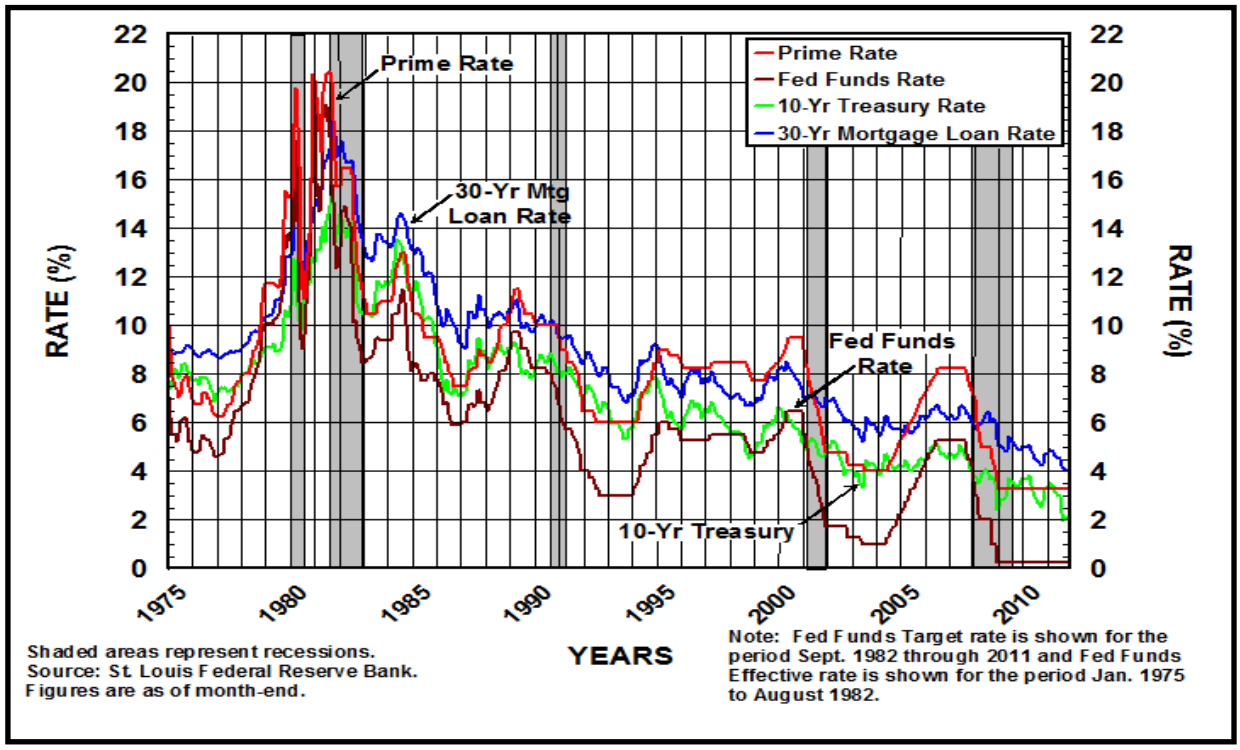
In the late 1970s and early 1980s the country was ravaged by double-digit inflation and interest rates. As shown in Figure 1, at year-end 1977 the fed funds rate was 6.5% and the prime rate was 7.75%. As interest rates increased, both the fed funds rate and the prime rate reached levels approximating 20% thus causing depository financial institutions to be hard hit due to the rapidly rising cost of their deposits, most of which were short-term. What was then known as the Savings & Loan (S&L) Industry was especially devastated due to their large holdings of fixed-rate, 30-year mortgage loans funded almost exclusively by

short-term deposits. After several years, negative spreads between interest income and interest expense decimated the financial strength of the industry.

The problem was compounded by legislation passed in the early 1980s that allowed S&Ls to expand into commercial real estate and development lending. The purpose of this was to allow S&Ls to "grow their way out of the problem." In the years to follow, this resulted in widespread loan losses, insider dealings, and fraud thus exacerbating the problems brought about by double-digit interest rates. Many of the institutions that were weakened from the adverse effects of rising interest rates were unable to recover from the newly emerging credit problems.

By the early 1990s the failure of over 1,200 S&Ls reduced the industry by roughly one-third of its original size. This gave rise to the S&L Syndrome that has haunted managers of financial institutions and regulators ever since. In a later section we will examine the S&L collapse in detail with emphasis on interest rate risk.

FIGURE 1: Interest Rates 1975-2011



Like Fannie Mae and Freddie Mac, the S&L industry was created by Congress to promote home ownership. In order to receive favorable tax treatment S&Ls were required to keep most of their assets in mortgage loans, virtually all of which at that time had 30-year original terms with fixed rates. If loan demand was insufficient to reach this goal Ginnie Mae mortgage-backed securities made up the difference. These were also pools of 30-year fixed-rate mortgage loans. As will be shown analytically later in this paper, the S&L industry was, like Fannie and Freddie, destined to fail albeit for different reasons.[1] But they all had a common ingredient—a Congressional mandate to promote housing in order to meet social goals.

[1] The S&L problems were precipitated by a legislatively mandated balance sheet structure that proved to be unsustainable when interest rates increased dramatically and remained at elevated levels. Subsequently, loan losses

B. Regulatory Response

In the aftermath of this crisis, in the 1980s regulators of depository institutions understandably responded by requiring that management focus more attention on the balance sheet structure. Other than requiring an ALM policy, there was no formal guidance although analytical procedures began to evolve as discussed later. As that evolution took place, the balance sheet of depository institutions evolved into more complex institutions with far more products and extensive optionality on both sides of the balance sheet. The surviving S&Ls evolved into what are now known as thrift institutions with much lower concentrations of fixed-rate mortgage loans. Aided by major developments in software and computing power, this evolution also brought about a higher level of knowledge and sophistication on the part of management and regulators and resulted in a more formal and focused approach toward the ALM/IRR management process.

Excessive holdings of fixed-rate, 30-year mortgage loans was the primary culprit in the S&L debacle. In the years that followed, this resulted in special attention by regulators on those institutions holding such loans in an amount deemed to be excessive. Although well-intentioned, these thresholds were often arbitrary and ignored other critical, risk-mitigating aspects of modern balance sheets. This will become evident in a later section that takes an in-depth, analytical look at the S&L industry's balance sheet and why so many failed.

Although mortgage loans played a key role, there were other contributing factors as well. This is a critical point. It is insufficient to just look at fixed-rate mortgage loans as the primary or sole determinant of risk. The risk mitigants—or the lack thereof in the case of S&Ls—on the rest of the balance sheet must be examined as well. Rather than zeroing in almost exclusively on a single, admittedly high-risk product, risk managers must focus on the entire balance sheet and how its structure affects future earning power and capital formation under stressful conditions. This shows up in the following definition of ALM.

C. Definition of ALM

The first step in measuring and managing IRR is to have a clear definition of that process as well as its objective. As shown later, this helps both practitioners and regulators understand what the process is and

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on new commercial business and fraud played a major role in contributing to the demise of the industry. Fannie and Freddie on the other hand, failed primarily due to housing-related credit risk. They were the largest participants and primary drivers of the sub-prime mortgage market during the financial crisis that peaked in 2008. Almost one-third of their direct purchases were subprime and during the peak of the housing bubble almost 40% of newly issued private-label subprime mortgage-backed securities were bought by Fannie and Freddie. Their resulting collapse, like that of the S&L industry, ended up costing taxpayers about $151 billion by late 2011 and the meter is still running. It is interesting to note that some of their financial problems were ALM-related, that is, a result of hedging with interest rate swaps that went the wrong way and contributed to operating losses. Since these entities hold about $1.5 trillion in fixed-rate mortgage loans on their balance sheet it is natural to want to hedge against the adverse effect of rising rates on their funding cost. But was this hedging an ALM strategy or outright speculation gone awry? This question is important because these two firms have had enormous government-sponsored ability to hedge their IRR through the on-going issuance of callable bonds in many maturities and with a wide assortment of contractual characteristics without resorting to any such hedging. Properly used, these bonds are an ideal way for the issuer to hedge IRR without the steady flow of hedge-related hits to their bottom lines, as well as that of Uncle Sam. A related question is—where were their ALM experts?

equally important—what it is not. Since the term *Asset-Liability Management* is hyphenated this sends an important clue. The narrow definition is as follows:[2]

> *Asset-Liability Management is a forward-looking process involving the simultaneous management of assets and liabilities to measure, monitor, and control the effects of changing interest rates on income, asset values, liquidity, and regulatory capital.*

Virtually all financial institutions have a normal, structural imbalance between the repricing attributes of assets versus liabilities. As pointed out earlier, this imbalance is a primary source of institutional compensation, along with the assumption of credit risk. However, it can also be a primary source of risk and thus financial and regulatory problems if it is not effectively managed as the S&L industry discovered.

When deposit rates reached double-digits in the early 1980s, the net interest income (NII) plunged as did net income (NI) thus rapidly eroding regulatory capital. But a companion problem emerged. The inability of S&Ls to keep pace with the rising cost of deposits caused a massive exodus of funds to higher yielding alternatives, most notably money market mutual funds and bond funds that had double-digit returns. Thus, the magnitude of the structural imbalance in the asset and liability mix produced not only a devastating income problem due to a rapidly rising cost of funds relative to the fixed asset returns, it produced a severe liquidity problem.[3]

This highlights an important aspect of ALM and the definition given above. If rising rates cause an income problem due to the inability to reprice assets *reasonably commensurate* with rising deposit costs, this reduces the institution's ability to pay competitive market rates and retain deposits. In other words, *the flip side of an ALM-related income problem is a liquidity problem.* They usually go together and both can have a corrosive effect on capital, financial performance, and safety and soundness.

III. ANALYTICAL PROCEDURES

A. Objective of ALM

The primary objective of an ALM analysis is to provide an early warning of possible financial problems resulting from the effects of changing interest rates on the existing balance sheet and income performance. As pointed out, such problems manifest themselves when the cost of liabilities increases faster than the returns on assets in a rising rate environment. Correspondingly, in a falling rate environment, asset returns may decline faster and more than liability costs. To the extent that such a problem is detected for either rising or falling rates, preventative action should be implemented. To achieve this objective, analytical procedures must be appropriate and correctly applied. In this section,

[2] Some analysts might define ALM in a much broader sense to include virtually all aspects of financial management including credit risk. However, for the purpose of this paper the narrower definition focusing only on interest rate risk is used. This is also more in keeping with the origin of the term in the aftermath of the S&L crisis.

[3] In the early 1980s the ability of S&Ls to raise rates to compete was initially hampered by the infamous Regulation Q that limited the rates depository institutions could pay on deposits. Although this restriction was phased out over several years thus allowing deposit rates to increase, the S&Ls were losing so much money and eroding capital at such a rapid pace that they could not afford to keep paying market rates so the process of "disintermediation" resulted in an unprecedented liquidity crisis. The term "disintermediation" was widely used during the S&L crisis to describe the process by which savers switched deposits from regulated financial intermediaries that were paying below-market rates to higher yielding alternatives such as money market mutual funds and bond funds whose rates were not regulated. This liquidity problem was temporarily resolved when legislation was enacted allowing institutions to offer tax-exempt "all-saver certificates" at double-digit yields. However, S&Ls continued on their death march due to operating losses and capital erosion.

the most commonly used procedures—Net Economic Value (NEV) and Income Simulation—are examined along with their advantages, disadvantages, implementation issues, and misconceptions. [4]

B. Net Economic Value (NEV)

NEV is a market-based valuation approach. It is the difference between the present value of *existing* asset-related cash flows and liability-related cash flows which are discounted at either current or shocked market rates for those products. The resulting difference is the capital (or net worth) expressed in terms of current market value or shocked market value rather than book value. When the current market value of capital is divided by the current market value of the assets, this ratio is known as the Pre-Shock or Current NEV.[5] A Post-Shock or Shocked NEV reflects the estimated market value of capital under hypothetical, alternative interest rate scenarios such as a parallel, sustained rate shock of +300 basis points (BPs).[6] To see how this theoretical procedure works, consider the following simplified balance sheet and the related market values of the assets and liabilities under a parallel +300BP shock test shown in Figure 2.

FIGURE 2: Simplified Balance Sheet & NEV Analysis

		Market Values	
	Book	**1. Current**	**2. Shocked**
Assets	**Value**	**Value***	**+300BP**
4-Yr 5% Bonds	$100M	$100M	$89.9M
Liabilities			
1-Yr 2% CDs	$90M	$90M	$87.4M
Capital	$10M	$10M	$2.5M
Capital & NEV Ratios	10%	10%	2.8%

**For simplicity it is assumed throughout this paper that the Current Market Values = Book Values.*

A casual look at this balance sheet shows a structural imbalance with 4-year 5% bonds financed with 1-year 2% CDs and Capital. But just how bad is this imbalance? Is the capital sufficient to support the risk implied by this structure? To attempt to answer these questions, the Shocked NEV concept is applied.
Note that in a +300BP shock test the value of the $100M in bonds falls by 10.1% to $89.9M while the $90M in CDs falls 2.6% to $87.4M. This disparity caused the dollar value of capital at market value to decline 75% to $2.5M. The resulting Shocked NEV ratio is 2.8% ($2.5M / $89.9M) for a decline of 720 basis points from the no-shock scenario.

In order to prevent such erosion 1) the assets (bonds) would have to be shorter in maturity and reprice sooner; 2) the CDs would have to be longer in their maturity and reprice later; 3) the initial capital would have to be higher and correspondingly the amount in the CDs lower; or 4) some combination of the three. The decline in the value of assets relative to the liabilities reflects the extent of the structural imbalance and the ability (or inability) of the entire balance sheet to reprice to the new market conditions. In this sense the Shocked NEV is like a pressure gauge for future earning power of the current balance sheet.

[4] Net Economic Value is also referred to as the Economic Value of Equity (EVE) and Net Portfolio Value (NPV). The term NEV will be used in this paper.
[5] Although not intended for this purpose, the Current NEV in either dollars or as a ratio may be viewed as an estimated proxy for liquidation value. In most cases this is not a relevant issue, in others it may be, as shown later.
[6] The nature of rate scenarios warrant additional attention as discussed later.

This simple example illustrates the role of the initial capital in absorbing risk. The higher the initial capital ratio, the more IRR that can be safely taken. Bear in mind that effective risk taking—whether it is credit risk or IRR—is the primary source of institutional compensation.

1. Advantages of NEV. When properly used, this approach provides considerable insight into the IRR problem. The Shocked NEV is a single, all-inclusive summary statistic that captures complex relationships involving financial products that span many years such as mortgage loans as well as products with embedded options and various repricing attributes.

Under this market value approach, the relative devaluation of assets versus liabilities as summarized by the Shocked NEV sends an early warning regarding possible adverse pressure on income, liquidity, market values, and capital. To the extent that assets decline *significantly* in value relative to liabilities in a rising rate scenario, this indicates that asset returns may lag behind liability costs thus exerting pressure directly on the future NII and as a result, the NI and capital. If this causes severe income problems such that the institution is unable to pay competitive rates, a liquidity crisis could emerge as well. Under such conditions, existing liquidity can be used initially to fund deposit outflows but if this is insufficient, assets may have to be sold to meet these outflows. However, such sales will be at losses due to the higher market rates thus exacerbating the income problem and, depending on the extent of that problem, accelerating the erosion of capital.

2. Limitations of NEV. In the simple example above, the shocked NEV is a single risk measure of 2.8%. By itself this number lacks context. That is, *in the absence of supporting information it is often difficult to say where a particular NEV figure lies on the IRR spectrum and there is no explicit reference to the effects of changing interest rates on income and capital formation.* Furthermore, this risk as measured by the Shocked NEV should be related to the institution's ability to absorb that risk, i.e., its capital.

There are several ways to address these issues. The first is to consider the basis point change in the NEV relative to the Post-shock NEV. In the example above this would mean relating the decline of 720 basis points to the Post-shock NEV of 2.80%. This procedure was used by the former Office of Thrift Supervision (OTS) and will be demonstrated later. The second is to examine the % change in the NEV. In the example above, this change was a decline of 75%. This procedure is a measure of the impact of rising rates on the balance sheet, the related income statement and capital. When related to the Pre-Shock NEV, the % change in the NEV also reflects the risk-bearing capacity of the institution by focusing on the decline in capital at market value. In this sense, this approach may be viewed as a proxy for determining liquidation value under stressful interest rate conditions. As shown later and like the OTS approach, this procedure can provide an effective early warning of potential problems. However, extreme care must be exercised using both approaches when interpreting the NEV results of institutions that have unusually low or high initial capital ratios. To see this, consider the comparison of three institutions shown in Figure 3 below.

FIGURE 3: Risk Comparison

	Institution		
	A	**B**	**C**
Pre-Shock NEV	6%	10%	14%
Post-Shock NEV	3%	5%	7%
% Change	-50%	-50%	-50%
BP Change	-300BPs	-500BPs	-700BPs

Note that the Post-Shock NEV for institution A is only 3% versus 5% and 7% for B and C. Looking at this in isolation might suggest that A has the highest IRR because of its low Post-Shock NEV. But this is not necessarily the case. In fact, *it may have the lowest interest rate risk*. The basis point change between the Pre- and Post-Shock NEV is only -300BPs for Institution A versus -500BPs for B and -700BPs for C! The % Change from the Pre-Shock NEV is the same at -50% for all three so in this regard the risk appears to be the same. Clearly, C has the most interest rate risk in light of the basis point change but it also has the highest risk-absorbing capability with a Pre-Shock NEV ratio at 14%. On the other hand, A may have the least IRR but it also has the least risk absorption capability.

This comparison highlights a critical distinction that must be made in a risk assessment. While the resulting Post-Shock NEV ratio is important, it is the extent of its erosion both in basis points *and* as a % change that actually measures the impact of rising rates whereas the Post-Shock NEV ratio provides insight regarding the ability of the institution to support that risk. The % change provides a valuable added dimension to this analysis because it reflects the erosion of capital on a market value basis. However, this metric must be used with caution because the same % change can reflect varying degrees of risk depending on the initial capital level of the institution as shown in Figure 3.

To summarize, if the Pre-Shock NEV is low to begin with as in the case of A, the Post-Shock NEV will also be low, perhaps misleadingly so and reflecting interest rate risk that may not be present. Thus, it is important to distinguish between what may be a low capital problem as in A, an IRR problem as in C, or possibly a combination of both as in B. This is where judgment comes into play and additional risk measurement metrics must be utilized to make a reasonably definitive IRR assessment.

If A is perceived to have a high degree of IRR and is forced to reduce what may actually be minimal risk, this could induce or contribute further to an income problem and diminish the institution's ability to increase or maintain capital. Institution C on the other hand has what appears to be a high IRR level. These issues raise several questions:

- How will income and thus capital (at book value) be affected in a multi-period income simulation shock test?
- If income and capital are adversely affected, at what point should regulatory intervention occur pursuant to capital requirements?
- Is regulatory capital sufficient to ride out the IRR problem and how long will it take for income to recover?

The NEV approach can provide considerable insight in an IRR assessment but the income and capital-related questions are not explicitly addressed in an NEV analysis. Another important limitation of the NEV approach is that it provides little or no useful insight in an analysis of falling or stable rate environments. Finally, the results of an economic value analysis such as the NEV are heavily dependent on certain assumptions related to deposits. These assumptions, which are discussed in detail later, can vary considerably from one institution to another. Against this background, it is now useful to examine the regulatory approaches to IRR measurement.

3. OTS Approach. In the aftermath of the S&L crisis, regulators intensified their focus on the IRR problem. The primary regulator of federally-insured S&Ls at that time, the Office of Thrift Supervision (OTS), developed an IRR approach that was later applied to thrift institutions under its jurisdiction. [7] This model is shown in Figure 4.

[7] The OTS was merged into the Office of Comptroller of the Currency (OCC) in July, 2011. The OCC regulates all federally-chartered banks. The future application of this model by the OCC is unknown.

FIGURE 4: OTS Risk Matrix

Post-Shock NEV Ratio (+200BP)	Basis Point Change in NEV Ratio Shocked +200BP			
	0-100BP	**101-200BP**	**201-400BP**	**> 400BP**
> 10%	Minimal Risk (1)	Minimal Risk (1)	Minimal Risk (1)	Moderate Risk (2)
6% to 10%	Minimal Risk (1)	Minimal Risk (1)	Moderate Risk (2)	Significant Risk (3)
4% to 6%	Minimal Risk (1)	Moderate Risk (2)	Significant Risk (3)	High Risk (4 or 5)
Below 4%	Moderate Risk (2)	Significant Risk (3)	High Risk (4 or 5)	High Risk (4 or 5)

Source: "Thrift Bulletin 13a, Management of Interest Rate Risk, Investment Securities, and Derivative Activities", Office of Thrift Supervision (OTS), Department of the Treasury, December 1, 1998. (The numbers in parentheses were the guidelines used by OTS examiners when assigning a rating to the interest rate sensitivity ("S") component of the CAMELS rating for thrift institutions.

The OTS matrix attempted to relate IRR in the form of the basis point change in the NEV to the Post-Shock NEV using its standard, parallel shock test of +200BPs. Note that depending upon the intersection of the BP change and the Post-Shock NEV ratio, the risk was defined by the modifiers as minimal, moderate, significant, and high. The numbers in parentheses were used as *guidelines* rather than rigid rules by examiners when assigning a rating to the interest rate sensitivity ("S") component of the CAMELS rating for thrift institutions.

This approach is sound in theory in that it attempts to evaluate risk in relation to the ability of the institution to handle that risk. From the standpoint of the regulators, it was used to provide insight regarding the IRR position of individual institutions and the thrift industry as a whole. Since it was applied uniformly to thrifts without regard to behavioral rate-setting differences, its results undoubtedly had measurement error as they applied to specific institutions. For this reason, the results were used as guidelines rather than definitive results. As shown later, it was an effective early warning stress test. Despite its more robust approach, the major drawback of the OTS methodology is its lack of explicit or direct inference regarding the effects of changing rates on earning power and ultimately, regulatory capital. An ALM analysis should address these issues.

4. NCUA Approach. The NCUA approach focuses on the Post-Shock NEV not breaching 4% in a +300BP Shock Test *and* the percent decline from the Pre-Shock NEV not exceeding 50%. As pointed out earlier and demonstrated in Figure 3, this approach may be biased against institutions with low capital ratios and it may not reveal a high risk profile in those with high capital ratios. Thus, special care must be exercised when assessing IRR in these institutions.

Despite this caveat, focusing on the Post-Shock NEV and the related % change properly reflects three critical points that are of concern to regulators regardless of the initial capital level. First, a low Post-Shock NEV means that there is a low margin of safety not only to absorb IRR but *all* of the other risks embedded in that institution. Second, a low Post-Shock NEV may signal a reduced timeline necessary to recover from the adverse effects of IRR. Finally, such a situation may pose a greater threat to the deposit insurance fund administered by the NCUA. Thus, from a regulatory standpoint, even a low degree of IRR can be problematic in an institution with a low initial capital ratio.

Since the income implications of an NEV analysis are implied rather than explicit, context is necessary. Recognizing this, the NCUA published income simulation guidelines on the extent to which the net

interest income (NII) can decline in a shock test from a base case. Currently, in a +300BP test a decline greater than 30% is deemed to be "high risk."[8]

There is another issue that is unique to the NCUA's approach. When its NEV risk thresholds were initially published the prevalent analytical practice was to value checking, savings and money market accounts at par (or book value) based on the fact that these deposits are immediately withdrawable. However, it is well recognized that these non-maturity deposits (NMDs) collectively behave as if they are longer-term deposits. That is, they may have theoretical, risk-reducing attributes by declining in value in a rising rate environment such that the decline offsets a portion of the decline in the value of the assets thus protecting the market value of capital. [9] This may improve the NEV ratio considerably depending on the valuation assumptions. Although the NCUA recognizes the general validity of this procedure, *the NEV risk thresholds mentioned above apply only when NMDs are valued at par in contrast to the OTS that used short average maturities on NMDs in concert with its risk matrix.*

5. Perspective. The different approaches reflect the complexity of the IRR problem. Except perhaps in rare cases, risk, as commonly perceived, is virtually impossible to measure accurately by focusing primarily on a single statistic like the shocked NEV. Like a precious gem, all of its facets must be examined to see what lies beneath the surface. The FICO score in a consumer loan request for example, must be augmented by the debt-to-income ratio, the downpayment, and any additional information available to the lender. The risk of a mortgage loan has many facets other than just the LTV, as critically important as that is. The risk of a common stock goes beyond the so-called *beta*, a common risk measure. The same can be said of the NEV approach in the assessment of IRR.

In order to maximize the effectiveness and analytical power of an NEV analysis, it must be supported with complementary analyses that provide the necessary income and capital context to both managers and regulators. This context is provided by an extended, multi-year income simulation analysis.

C. Income Simulation

Recall from the definition provided earlier that one of the objectives of ALM is to determine the impact of changing interest rates on earning power and regulatory capital. *This being the case, the logical thing to do is to estimate those effects and thus provide the necessary context for NEV.* Later in this paper detailed analyses of the S&L industry using *both* NEV and income simulation will be provided to illustrate this key point. But to first lay the necessary groundwork, consider the income statement shown in Figure 5 below. This is derived from the simplified balance sheet shown in Figure 2 and for which the corresponding NEV analysis was derived.

[8] The NCUA also uses a so-called "17/4 scope test." After devaluing fixed-rate mortgage loans 17%, variable-rate real estate loans 4%, and securities based on their maturity or average life, the book value of capital is reduced by the total amount of these deductions. The resulting adjusted value of capital is then divided by assets to estimate the shocked NEV ratio. If this ratio falls below 4%, further IRR investigation may be conducted. Another scope test is the "Net Long-Term Assets ratio." This focuses mainly on the sum of fixed-rate mortgage loans, investments with a final maturity or average life exceeding three years, business loans, and fixed assets as a percent of assets. When this ratio exceeds 25%, more attention is focused on IRR. (This ratio may also be expressed as a % of net worth.) It is important to note that these tests focus only on the asset side and they are *not* definitive risk measures. Rather, the results are used to allocate resources or to decide if the scope of the IRR component of an examination should be expanded. In that event, other aspects of the balance sheet are examined in more detail along with risk mitigants and the institution's ALM analysis.

[9] The NMD issue is discussed in more detail later.

FIGURE 5: Income Simulation

	Yr 1	Yr 2	Yr 3	Yr 4
1. No Rate Change:				
4-Yr 5% Bond Interest Income	$5.0M	$5.0M	$5.0M	$5.0M
1-Yr 2% Certificate Expense	$1.8M	$1.8M	$1.8M	$1.8M
Net Interest Income (NII)	**$3.2M**	**$3.2M**	**$3.2M**	**$3.2M**
(Note: The NII generated by the zero-rate change scenario in Year 1 is the base against which NII changes are evaluated.)				
2. Rate Change: +300BPs				
4-Yr 5% Bond Interest Income	$5.0M	$5.0M	$5.0M	$5.0M
1-Yr 2% Certificate Expense	$1.8M	$4.5M	$4.5M	$4.5M
Net Interest Income (NII)	**$3.2M**	**$0.5M**	**$0.5M**	**$0.5M**

1. Net Interest Income (NII). Note that the focus is on the impact of changing interest rates on the Net Interest Income (NII) rather than Net Income (NI). The NII is the difference between the asset returns and the corresponding cost of liabilities. As shown in Figure 5, the analytical starting point is the No Rate Change scenario. The results in Year 1 of this scenario represent the base case against which the changes in interest income and interest expense are evaluated as market rates change. These changes will occur depending on the timing of the asset and liability repricing, the new rate levels, and the responsiveness of the assets and liabilities. The structural imbalance produces a volatile income pattern with the net interest income (NII) declining 84% from $3.2M in Year 1 of the base case to $0.5M starting in Year 2 when the cost of funds increases significantly.

The NII behavior is the primary focus of an income simulation analysis because it is this interaction of interest income and interest expense that causes the NII to change as interest rates change.[10] The Shocked NEV ratio of 2.8% shown in Figure 2 is a vague summary measure of this interaction, the current capital ratio, and ultimately the impact of changing interest rates on statutory capital. While some analysts argue that the NEV approach is a better analytical tool than income simulation, or vice-versa, this simple example shows that both approaches are complementary and closely related. When used properly and combined with sound judgment, both can provide considerable insight in an IRR analysis as will be shown.

An Income Simulation analysis does not produce a forecast of future income. Rather, it is an estimate of the *directional sensitivity* of the NII due to the repricing interaction of the existing assets and liabilities over time resulting from a particular yield curve shift. In this sense income simulation provides a direct estimate of earning power at risk. Estimating future interest income and expense in an accounting sense is a very different problem that encompasses not only the repricing interaction of the existing (known) assets and liabilities, but in addition the (unknown) changes in the existing balance sheet composition, (unknown) growth, and the (unknown) interest rate environment going forward.

Clearly, the major component of these influences is the known, *existing* balance sheet and for this reason, it is the focus of an ALM analysis. Considering the existing balance sheet along with the other elements has another name—budgeting. But the budgeting process is not a risk assessment. To the extent that the initial balance sheet is allowed to grow over time in an ALM analysis, the resulting projected NII would be inconsistent with both the Post-Shock NEV and the projected NII as derived from the existing balance sheet. *For every NEV analysis of an existing balance sheet, there is a related income stream so a shocked NEV and the corresponding income simulation results are two sides of the same coin.* If the initial balance sheet is allowed to change over time in a simulation in order to produce a different income

[10] The impact of a changing NII on net income (NI) is important as well. But the NI is also affected by operating expenses, loan loss provision expense and fee income, none of which is directly affected by changing interest rates, at least in the short run. The NI effect is examined in the next section dealing with an analysis of the S&L industry.

stream, a process sometimes referred to as a "dynamic" analysis, you then have two different coins. The Federal Financial Institutions Examination Council (FFIEC) raised concerns about this practice in its Advisory on IRR:

> *…dynamic simulation is highly dependent on key variables and assumptions that are extremely difficult to project with accuracy over an extended period. Furthermore, model assumptions can potentially hide certain key underlying risk exposures.*[11]

FFIEC's concern with this approach is that the risk embedded in the existing balance sheet can be obscured or essentially assumed away by assumptions that may not materialize. Clearly, any results from such an analysis cannot be viewed in the context of policy or regulatory risk guidance. If there is concern about the ALM results changing over time due to changes in the balance sheet, this is easily overcome by conducting frequent ALM analyses, i.e., monthly or quarterly. In this way, the impact of a shifting balance sheet will be identified as and if it is occurring.

This modeling procedure should not be confused with "what-if" modeling in which the existing balance sheet is altered on a proforma basis to test the IRR implications of new strategies or concentration limits prior to implementation. For example, determining the optimal amount of fixed-rate mortgage loans that can be held safely pursuant to an ALM Policy or Concentration Risk Policy can be determined by shifting funds from investments to those products. Similarly, a risk-mitigation strategy of funding fixed-rate mortgage loans with longer-term, fixed-rate FHLB funding can be tested in a variety of ways for income and risk implications.

2. Advantages of Income Simulation. Critics of income simulation argue that such an analysis is not comprehensive enough because by focusing on short-term income results, i.e., the next year or two, it fails to take into account the much longer-term nature of certain balance sheet components like mortgage loans and options that extend beyond such a short horizon. This is a valid criticism but it is easily resolved by extending the income simulation horizon. In the next section the S&L industry is analyzed using both NEV and a 5-year income simulation horizon. The income results over this extended horizon provide compelling insight, perspective, and context that supports and complements the NEV analysis.

By extending an income simulation analysis to include estimates for operating expenses, fee income, and loan loss provision expense, this approach can be used to provide additional context for NEV by explicitly estimating the extent of pressure changing interest rates can have on net income and thus statutory capital. In fact, as discussed later, an ALM analysis based solely on NEV with no reference to income simulation results may lead to erroneous conclusions regarding IRR.

Finally, the extended multi-year income simulation approach provides significant insight when assessing any rate scenario whereas the NEV does not reveal the magnitude of possible income pressure resulting from falling or even stable rates. This has been a problem since the Federal Reserve began its near-zero short-term interest rate policy in late 2008.

In the next section the NEV concept and income simulation will be brought together by conducting a series of three comprehensive ALM analyses of the S&L industry prior to its collapse. Even after several decades, there are still valuable lessons to be learned.

[11] Federal Financial Institutions Examination Council, *Advisory on Interest Rate Risk Management*, January 6, 2010, p. 4.

IV. THE S&L INDUSTRY—A POST MORTEM

Until the late 1970s the S&L industry was characterized as a highly cyclical business driven by interest rates. As long as rates fluctuated within a "normal" range of say +/-200 basis points as was common up to that point, the industry was able to survive recurring episodes of margin compression due to changing interest rates. But as pointed out earlier, in the late 1970s and early 1980s economic conditions changed as both interest rates and volatility increased dramatically. Note in Figure 1 that swings of 5 to 10 percentage points occurred within short periods. The balance sheet structure was such that the industry was unable to respond to this new environment. In this section we will examine the S&L industry's collective balance sheet as of 12/31/77, just prior to the unprecedented run-up in interest rates in the late 1970s and early 1980s.

A. The S&L Balance Sheet

The S&L industry's 1977 balance sheet is shown in Figure 6. It was a straightforward structure. Residential mortgage loans (1 to 4 family units) made up 74.4% of assets with mortgage-backed securities (MBS) making up 2.8%. Virtually all of these mortgage loans, including those in the MBS pools, had 30-year amortization terms and fixed rates. Thus, over 77% of assets were in such loans. The MBS were mainly Ginnie Maes that could be used to meet their legal housing-related requirements. Liquid investments at 7.6% of assets and consumer loans at 2.2% played a minor role as did commercial real estate loans at 8.6% of assets.

FIGURE 6: Condensed Statement of Condition, S&L Industry, Dec. 31, 1977

ASSETS	$ in Millions	% of Total	LIABILITIES & NET WORTH	$ in Millions	% of Total
Cash & Demand Deposits	$4,593	1.0%	**Savings Deposits**		
			Passbook Accounts (5%)	$146,742	32.0%
Liquid Investments			Certificates (7%)	240,133	52.3%
Federal Funds (6.5%)	4,593	1.0%		386,875	84.3%
US Treasuries (7.00%)	25,149	5.5%	**Borrowed Funds**		
Other Investments (7.25%)	4,862	1.1%	FHLB Advances (7.50%)	19,952	4.3%
	34,604	7.6%	Other Borrowings (8%)	7,851	1.7%
				27,803	6.0%
Mortgage-Related Assets					
Residential Loans [a] (8.96%)	341,690	74.4%	**Other Liabilities**		
Commercial Loans (9.25%)	39,526	8.6%	Loans in Process	9,932	2.2%
Mtg.-Backed Sec. [b] (8.25%)	12,701	2.8%	Other Liabilities	9,491	2.1%
	393,917	85.8%		19,423	4.3%
Consumer Loans (8%)	10,287	2.2%	**Net Worth**	25,181	5.5%
Other Assets			**Total Liab & Net Worth**	**$459,282**	**100%**
FHLB Stock	3,200	0.7%			
Building, Equip., Other	11,681	2.5%	[a] 1 to 4 family units and apartments		
	15,881	3.2%	[b] Primarily passthrough securities		
Total Assets	**$459,282**	**100%**			

Source: U.S. League of Savings Associations, Savings & Loan Fact Book, 1978, p 80. The rates shown in parentheses were the current market rates at that time and were obtained from the St. Louis Federal Reserve Bank or estimated by the author.

On the funding side so-called passbook accounts made up 32% of Liabilities & Net Worth. These deposits were withdrawable on demand but for reasons discussed later, a 3-year average maturity assumption was used in the three NEV analyses that follow in order to compute their theoretical value.

Certificates were the other primary funding source at 52.3% of Liabilities & Net Worth. Note that there were no money market accounts (MMAs) as these came about several years later. The MMA is an important product for IRR management because it allows more effective segregation of rate-sensitive balances from less rate-sensitive balances. In the absence of such an account, rate-sensitive and non-rate sensitive balances were comingled in the passbook account. This potentially sensitizes the entire savings account balance and requires rapid and aggressive rate increases on the entire account in order to retain the rate-sensitive balances.

Some of the data necessary to conduct these analyses were not available in the 1978 S&L Fact Book that was the source of the balance sheet. Thus, estimates had to be made using published market rates at that time, some of which are shown in Figure 1. Also, assumptions had to be made regarding the cost and maturity structures of the CDs, FHLB advances, and other borrowings.[12]

Before analyzing the results it is worth noting several other aspects of the S&L balance sheet. First, unlike modern institutions there were no variable-rate loans such as ARMs or home equity lines of credit (HELOCs) at that time. The latter came into existence in the late 1980s and they are now especially important products for IRR mitigation due to their rapid repricing, usually monthly and tied to the prime rate. With this repricing structure these loans reprice basis-point-for-basis-point and with virtually no lag. The speed and magnitude of this repricing can be an offset to the lack of repricing on a significant portion of fixed-rate mortgage loans. A second risk mitigant that was missing from the S&L industry at that time was low-cost checking accounts. This is an important source of stable, non-rate sensitive funding.[13] Finally, note that the capital ratio was only 5.5%. This hardly seems sufficient to support the obvious structural imbalance in the balance sheet.

ALM analyses will be conducted for three interest rate shock tests and scenarios in order to accomplish the following objectives:

- Determine the effectiveness of the current regulatory IRR guidelines in providing the necessary early warning of impending problems;
- More fully develop the complementary relationship between the NEV and income simulation approaches;
- Provide the necessary context for both regulators and risk managers as it relates to the predictability of future earning power and regulatory capital; and finally
- Provide an overall framework for the assessment of IRR.

B. ALM Analyses of the S&L Industry

Bear in mind that the NEV approach focuses indirectly on the impact of changing interest rates on the NII. But in order to provide context and relate the NEV results to net income and regulatory capital, estimates were made for future operating expenses (2% of assets), fee income (.20% of assets), and provision for loan loss expense (.15% of loans). These estimates are consistent with the operating results of S&Ls at that time. Income taxes are ignored for reasons that will become apparent.

Another important assumption is the manner in which changes in interest rates are transmitted to the balance sheet for the purpose of repricing. In this process, a distinction must be made between behavioral rate-setting in which management has some discretion and market-driven rate adjustments where management has no pricing discretion. On the deposit side, rates are assumed to increase by 80% of the

[12] The average maturity of CDs was 14.9 months and 23.5 months for borrowings. For the other major assumptions used in this analysis, contact the author's firm at staff@brickinc.com.
[13] These accounts are discussed in more detail later.

rate shock with a one-month lag for the passbook accounts. This is a very high degree of rate sensitivity for a savings account and it is due to the lack of a money market account at that time. Maturing debt is rolled over at market rates that increase by 100% of the rate shock which is ramped over a 12- or 18-month period as indicated for income simulation purposes. Loan runoff and prepayments are assumed to be redeployed at rates that are increased by 50% of the rate shock.[14]

1. Scenario 1—OTS Model. The first ALM scenario applies the standard OTS test of a +200BP parallel and sustained rate shock to the balance sheet shown in Figure 6. Recall that the OTS used the risk matrix shown in Figure 4. The basis point change in the NEV is related to the Post-Shock NEV but with no specific reference to the impact of changing rates on the NII or NI. For the purpose of providing context we have added the projected income effects using a 12-month ramp. As the results show in Figure 7, the basis point change is -678BPs (Line A5b) and the Post-Shock NEV Ratio is -1.30% (Line A5d) in the +200BP test. [15] On a market value basis the capital of the industry would have been wiped out. As the OTS Table in Figure 4 indicates, this was a "High Risk" position, to the surprise of absolutely no one. In fact, these results are literally off the chart.

FIGURE 7: Simulated Performance of S&L Industry, 12/31/77
OTS Model: Immediate +200BPs for NEV, Ramped 12 Months for Income Simulation
($ in millions)

A. Shocked Market Value Effects:	
1. Capital at Book Value ($)	25,181
2. Capital Ratio at Book Value	5.48%
3 Current NEV ($)	25,181
4. Current NEV Ratio	5.48%
5. Shocked NEV ($)	-5,478
5a. $ Change from Current NEV	-30,659
5b. BP Change from Current NEV	-678
5c. % Change from Current NEV	-121.75%
5d. Shocked NEV Ratio	-1.30%

		Shocked +200BP (12-Month Ramp)				
B. Projected % Change in:	**No Shock**	**Yr 1**	**Yr 2**	**Yr 3**	**Yr 4**	**Yr 5**
1. Net Interest Income (NII)	-	-14%	-36%	-39%	-40%	-38%
2. Net Income (NI)	-	-50%	-127%	-140%	-142%	-135%
C. Simulated Key Ratios:						
1. Interest Inc/Avg Assets	8.33%	8.41%	8.56%	8.69%	8.81%	8.92%
2. Yield on Avg Earn Assets	8.79%	8.80%	8.96%	9.09%	9.22%	9.33%
3. Cost of Funds (COF)	6.34%	6.80%	7.59%	7.80%	7.92%	7.96%
4. Net Interest Margin (NIM)	2.80%	2.40%	1.80%	1.71%	1.70%	1.75%
5. Return on Assets (ROA)	.74%	.37%	-.20%	-.30%	-.32%	-.27%
6. Proj Capital Ratio at BV	6.18%	5.84%	5.64%	5.36%	5.06%	4.81%

Now consider the income simulation results. The NII (Line B1) declines sharply from the projected NII in the no-shock scenario and it continues to deteriorate until it stabilizes in Year 4 at -40% but with no recovery in sight. *This is the critical contribution of an extended, multi-year income simulation—it provides the necessary context that complements the NEV analysis by directly addressing a) the estimated*

[14] This procedure reflects a flattening of the yield curve for income simulation purposes and the fact that long rates usually increase less than short rates in a rising rate environment. However, for NEV and valuation purposes the full rate shock is applied to the discount rates.

[15] All analytics in this paper were performed using the ***CU/ALM-ware*** System (Ver. 9.1), which was developed by the author's firm.

severity of the income problem; b) the timing and speed of income recovery or the lack thereof; and c) the explicit impact on regulatory capital.

The estimated impact on regulatory capital is especially noteworthy. If rates are unchanged the baseline ROA of .74% (Line C5) would increase the capital ratio at book value from 5.48% to 6.18% (Line C6), assuming full retention of earnings and no asset growth. As rates increase on a ramped basis the projected pressure on the net interest margin (Line C4) causes the projected net income as measured by the ROA to turn negative in Year 2 and the regulatory capital ratio is projected to erode from the current 5.48% to 4.81% (Line C6) by the end of Year 5. The magnitude of the declines in the NIM, ROA, and capital ratio in light of such a modest rate shock provides an early warning of a potential problem and it demonstrates how income simulation provides the necessary context for the NEV analysis. Bear in mind that this scenario is only a +200BP shock test. In the past, S&Ls were able to recover from such events because they were not sustained as in this case. From this analysis, it appears that the only reason this industry did not fail earlier due to rising rates was because they quickly receded.

2. Scenario 2—NCUA Approach. The National Credit Union Administration (NCUA) has regulatory jurisdiction over federally-insured credit unions. As pointed out earlier, its risk guidelines call for a Post-Shock NEV not to fall below 4% with the % decline not exceeding 50% in an immediate and parallel shock test of +300BPs. But recall that these guidelines are based on non-maturity deposits (NMDs) being valued at par rather than their theoretical value based on an assumed average maturity. However, in light of contemporary modeling procedures and for consistency across the various scenarios being analyzed, the theoretical value of the savings accounts assuming a 3-year average maturity will be used rather than par value. Therefore, the NCUA risk guidelines cannot be used as a benchmark in this scenario. As in the OTS analysis, we are estimating the income effects based on a 12-month ramp test since this is a more plausible scenario. (The issue of plausible shock tests is discussed later.) The results of this analysis are shown in Figure 8.

FIGURE 8: Simulated Performance of S&L Industry, 12/31/77
NCUA Test: Immediate +300BPs for NEV, Ramped 12 Months for Income Simulation
($ in millions)

A. Shocked Market Value Effects:	
1. Capital at Book Value ($)	25,181
2. Capital Ratio at Book Value	5.48%
3. Current NEV ($)	25,181
4. Current NEV Ratio	5.48%
5. Shocked NEV ($)	-20,789
5a. $ Change from Current NEV	-45,970
5b. BP Change from Current NEV	-1,066
5c. % Change from Current NEV	-182%
5d. Shocked NEV Ratio	-5.17%

		Shocked +300BPs (12-Month Ramp)				
B. Projected % Change in:	**No Shock**	**Yr 1**	**Yr 2**	**Yr 3**	**Yr 4**	**Yr 5**
1. Net Interest Income (NII)	-	-21%	-54%	-59%	-61%	-58%
2. Net Income (NI)	-	-75%	-193%	-213%	-217%	-208%
C. Simulated Key Ratios:						
1. Interest Inc/Avg Assets	8.33%	8.45%	8.70%	8.92%	9.13%	9.33%
2. Yield on Avg Earn Assets	8.79%	8.84%	9.11%	9.33%	9.55%	9.76%
3. Cost of Funds (COF)	6.34%	7.04%	8.22%	8.54%	8.72%	8.78%
4. Net Interest Margin (NIM)	2.80%	2.21%	1.30%	1.15%	1.12%	1.21%
5. Return on Assets (ROA)	.74%	.18%	-.70%	-.85%	-.90%	-.83%
6. Proj Capital Ratio at BV	6.18%	5.66%	5.00%	4.19%	3.33%	2.52%

The Post-Shock NEV ratio in this case is -5.17% (Line A5d) and the % change is -182% (Line A5c).[16] These are alarming numbers to say the least. Although not the focus of the NCUA approach, the basis point change in the NEV is a stunning -1,066 (Line A5b). This is another clear sign of an extraordinary level of risk. On a market value basis, capital would be wiped out and by a wide margin. This indicates a correspondingly high probability of huge losses to the deposit insurer if a) rates remain at an evaluated level for a sustained period; b) income does not recover; and c) liquidation is necessary. However, because of the income recovery issue and to provide context, the risk assessment must be augmented by the income simulation results.

In simulations involving an interest rate stress test, the near-term net interest income may decline but within a few years the NII may then begin a meaningful recovery even if rates remain at the elevated level. This would indicate the extent to which the asset side of the balance sheet is responding to the new rate environment. Thus, a key ingredient of this and any other IRR assessment using income simulation is not only the extent of the NII decline but the timeline and speed of its recovery. This requires an extended, multi-year analysis as discussed earlier.

The change in the NII from the base case is -21% in Year 1 (Line B1) which is also the ramping period. The NII declines over 60% by Year 4 with no meaningful recovery on the horizon. The projected net income (Line B2) is deep in the red in Year 2 with devastating consequences for the statutory capital. The initial capital ratio at book value was 5.48% (Line A2) and if rates were unchanged, the ROA of the S&L industry was projected to be about .74% (Line C5). Assuming no growth and full retention of earnings in the base case, the projected capital ratio would have increased to about 6.18% (Line C6). But in a +300BP test, by Year 5 the projected capital ratio at book value would have declined to only 2.52% (Line C6) due to the massive operating losses. Due to its low capital ratio and its risk level, the results indicate that the S&L industry would run out of time to recover from a sustained +300BP shock. Also, note the precipitous decline in the net interest margin (Line C4).

3. Scenario 3—Replicating Actual Events. Rather than focusing on the S&L problem in the context of regulatory testing processes, this ALM scenario will attempt to replicate what actually happened from the late 1970s through the early 1980s. This goes beyond seeking an early warning of an impending problem. An effective risk measurement procedure should be able to replicate results roughly commensurate with the actual outcome several years later. This is a form of backtesting.

As shown in Figure 1, from the late 1970s through the early 1980s interest rates increased as much as 10 percentage points. However, this was not on a sustained basis so a shock test averaging +500BPs was applied on a ramped basis over 18 months. Unlike the prior analyses, the speed and magnitude of this rate shock was sufficient to initiate the early withdrawal of CDs, a problem that plagued the industry at that time. This contributed to the S&L liquidity problem and an already rapidly increasing cost of funds as the deposit outflows had to be replaced at a much higher cost. For this analysis, an early withdrawal model was activated. This reduced the average maturity of CDs from 14.9 months in the base case to 12.5 months in the +500BP shocked scenario. The results are shown in Figure 9.

[16] For perspective and to analyze the risk profile in the context of the NCUA risk guidelines, the analysis was also run separately valuing the savings accounts at par. The resulting shocked NEV was -5.76% and the % change was -192% versus -5.17% and -182% change, respectively. The "improvement" shown in Figure 8 using the theoretical NMD valuation is a result of the 3-year average maturity assumption on the savings account coupled with the assumption that the savings rate would increase by 80% of the rate shock with a 1-month lag. The conclusion regarding an extraordinary degree of IRR is obviously unaffected by the NMD assumptions in this case.

FIGURE 9: Simulated Performance of S&L Industry 12/31/77
Replicate Actual Events: Immediate +500BPs for NEV, Ramped 18 Months for Income Simulation
($ in millions)

A. Shocked Market Value Effects:	
1. Capital at Book Value ($)	25,181
2. Capital Ratio at Book Value	5.48%
3. Current NEV ($)	25,181
4. Current NEV Ratio	5.48%
5. Shocked NEV ($)	-50,118
5a. $ Change from Current NEV	-75,299
5b. BP Change from Current NEV	-1,913
5c. % Change from Current NEV	-299%
5d. Shocked NEV Ratio	-13.65%

		Shocked +500BP (18-Month Ramp)				
B. Projected % Change in:	**No Shock**	**Yr 1**	**Yr 2**	**Yr 3**	**Yr 4**	**Yr 5**
1. Net Interest Income (NII)	-	-26%	-89%	-103%	-104%	-99%
2. Net Income (NI)	-	-94%	-320%	-370%	-372%	-356%
C. Simulated Key Ratios:						
1. Interest Inc/Avg Assets	8.33%	8.46%	8.92%	9.35%	9.77%	10.18%
2. Yield on Avg Earn Assets	8.79%	8.86%	9.33%	9.79%	10.23%	10.65%
3. Cost of Funds (COF)	6.34%	7.19%	9.41%	10.08%	10.32%	10.40%
4. Net Interest Margin (NIM)	2.80%	2.09%	.30%	-.09%	-.11%	.02%
5. Return on Assets (ROA)	.74%	.05%	-1.67%	-2.09%	-2.15%	-2.07%
6. Proj Capital Ratio at BV	6.18%	5.53%	3.94%	1.94%	-.17%	-2.25%

The predictive capability of the combined NEV and income simulation approaches is readily apparent. The incredible decline in the Post-Shock NEV of 1,913BPs (Line A5b) speaks for itself even in the absence of any other measure. Interestingly, if the shocked NEV ratio of -13.65% (Line A5d) is viewed as a proxy for liquidation value, and the negative value certainly has relevance in this situation, this strongly suggests that massive costs would be incurred by the insurer of S&L deposits at that time, the Federal Savings & Loan Insurance Corporation. Although augmented by credit- and fraud-related losses later in the 1980s, this is essentially what happened.

The NEV results are confirmed and placed in context by the precipitous declines in the NII and NI starting in Year 1, the first phase of the 18-month ramping period. Perhaps most important, note that the projected NIM (Line C4) is actually negative in Year 3. Once again, the income simulation results show no sign of a meaningful recovery in this sustained environment. Furthermore, note the erosion of regulatory capital (Line C6) such that by the end of Year 4 it is wiped out! Again, this is essentially what happened, thus causing regulators to struggle to keep the entire industry from collapsing in the early 1980s. (In 1981 the Federal Home Loan Bank Board allowed troubled S&Ls to issue so-called "income capital certificates" that were then purchased by the S&L's insurer. These were treated as capital thus providing the appearance of solvency.)

The extension of the income simulation analysis to include the impact of changing interest rates on net income and thus regulatory capital provides a critical and usually missing dimension to an ALM analysis. This approach provides an early warning of the possible need for regulatory intervention pursuant to Prompt Corrective Action (PCA) requirements. This is extremely important because such intervention must be predicated on actual regulatory capital ratios and not on the theoretical market value of capital (NEV) under a hypothetical shock test. Contrary to some earlier perceptions, there is nothing in the PCA regulations that says anything about a hypothetical, shocked NEV ratio relative to some threshold for PCA intervention.

In the S&L analyses, the horrendous NEV numbers reflect the gravity of the problem but as pointed out, they lack context unless they are at the extreme end of the risk spectrum. So just how bad are these NEV numbers? Here again, the income simulation results provide the necessary insight. To see this, note once again a) the magnitude or depth of the decline in both the NII and NIM; b) the lack of a meaningful recovery over the 5-year horizon; and c) the adverse effect on projected regulatory capital. This is a critical observation. The regulatory capital was projected to be wiped out long before there was any recovery in core earning power. *This is the message underlying the NEV numbers that by themselves lack context.*

With benefit of hindsight, the depth of this problem is now obvious. But the proper use of *both* income simulation *and* NEV clearly quantifies the problem and provides the necessary insight and guidance for risk managers and regulators in the IRR assessment process. *In practice, this insight is necessary because few IRR problems are as obvious as those of the S&L industry.*

4. Contingency Funding Stress Tests. Recall from the definition of ALM that one of the objectives is to control the effects of changing interest rates on liquidity. Although serious liquidity problems can arise independent of interest rates, a high-risk ALM position can result in a severe liquidity problem due to the inability of an institution to pay competitive deposit rates in a rising rate environment. Thus, an emerging and integral part of an ALM analysis is to determine the institution's ability to cope with significant deposit outflows under several scenarios ranging from no change in external interest rates to a significant increase in rates such that disintermediation is induced. [17]

To test the S&L industry's ability to cope with sudden liquidity or disintermediation effects, the following four contingency funding stress tests were conducted: [18]

- No Rate Change Scenario
  - Test 1 10% deposit outflow over 3 months
  - Test 2 20% deposit outflow over 6 months
- +500BP Shock Test Scenario
  - Test 3 10% deposit outflow over 3 months
  - Test 4 20% deposit outflow over 6 months

Before examining the results, bear in mind that liquidity pressure is a balance sheet phenomenon. When significant deposit outflows arise they are met by excess overnight funds, cash inflows from maturing investments, loan runoff, prepayments, the sale of investments, and possibly borrowing power. Since no information was available regarding the additional S&L borrowing power over that shown in Figure 6, this aspect of liquidity was ignored and the focus was on liquidity generated by the balance sheet. [19]

[17] The extent of disintermediation depends on several factors in addition to the inability to pay competitive rates in a rising rate environment. The speed and magnitude of the increases in interest rates, average maturity of the CD portfolio, managerial responsiveness, and early withdrawal penalties on CDs all play a role. Ordinarily, when considering the premature withdrawal of CDs, savers are reluctant to incur a penalty of lost interest especially if it invades principal. However, this reluctance can be overcome depending on the extent of income improvement. It is likely that increases in rates of 400 or 500BPs over relatively short periods would be sufficient to induce this process. This is what happened in the S&L crisis.

[18] This analysis was conducted using the ***CU/ALM-ware*** System (Ver 9.1).

[19] The ability to borrow from the FHLB during this turbulent period was most likely diminished due to operating losses and significant declines in collateral values. Similarly, the sale of investments could be hampered by the realization of losses in a rising rate environment.

The results of these stress tests were expected and yet surprising by the depth of the problem. The results also confirmed the fact that in a rising rate environment, a liquidity problem is indeed the flip side of an IRR problem.

Liquidity stress can be a problem even when interest rates are stable. Adverse publicity or large loan losses can precipitate major outflows as several big banks discovered in the financial crisis of 2008. The first two liquidity stress tests involving no change in rates show that the S&L industry was a crisis waiting to happen due to its long-term assets—loans and investments—producing insufficient levels of cash flows to cover outflows with any *margin of safety*.

In the first month of outflows spanning three months and amounting to a total of 10% of deposits over this period, the on-balance sheet cash inflows of the S&L industry covered cash outflows only .96 times; by the third month the liquidity coverage was only .62 times. (A liquidity coverage ratio of 1.0 means that projected inflows match outflows. A ratio less than 1.0 means the institution may be forced to borrow or sell assets to cover outflows.)

This first test of 10% outflows over three months shows that additional external liquidity support would have been needed. In the 20% outflow test over a six-month period the coverage was only .49 times by month 6. This suggests that even in the absence of the adverse effects of rising rates on cash flows, the S&L industry would have been subject to such latent and intense liquidity pressure that outside assistance in the form of substantial borrowings and/or government assistance would have been necessary.

In the next two liquidity stress tests, the 10% outflows over 3 months and 20% outflows over 6 months were augmented by the adverse effect of rates increasing 500BPs. As expected, the liquidity situation is far more dire as prepayments on mortgage loans and MBS declined sharply from normal levels thus reducing the already low cash inflows. In the first month of the 10% test, the coverage ratio was only .75 times; by the third month it was .43 times. By the sixth month of the 20% test, the coverage was only .36 times. Clearly, by any measure this was a liquidity problem just waiting to happen.

The advantage of using a stress testing procedure in an ALM analysis is that it adds additional context to the primary analytical tools for risk assessment, especially in a rising rate scenario. Such testing should be conducted periodically in the ALM process because the first line of defense against a major liquidity crisis is a sound ALM position. This is another valuable lesson from the S&L crisis.

V. IMPLEMENTATION & THE ROLE OF JUDGMENT

When implementing an ALM process, a number of complex issues arise that must be understood and dealt with in concert with the use of sound judgment. These issues are discussed in this section. Throughout earlier sections the role of judgment was cited to stress the fact that the ALM process is not a mechanical, "black box" exercise that always produces clear results on a pass/fail basis. This point will be stressed below.

A. Scenario Testing

In the interest of consistency and uniformity, regulators require a standard testing procedure as discussed earlier. Prior to its merger into the Office of the Comptroller of the Currency, the OTS used a +200BP parallel, instantaneous and permanent rate shock. The NCUA's test is similar but +300BPs. From a regulatory standpoint these are plausible tests but at the institutional level other tests should be conducted. The Federal Financial Institutions Examination Council (FFIEC) recognized this in 2010 when they said the following:

> *When conducting scenario analyses institutions should assess a range of alternative future interest rate scenarios in evaluating IRR exposure. This range should be sufficiently meaningful to fully identify basis risk, yield curve risk and the risks of embedded options. In many cases, static interest rate shocks consisting of parallel shifts in the yield curve of plus and minus 200 basis points may not be sufficient to adequately assess an institution's IRR exposure. As a result, institutions should regularly assess IRR exposures beyond typical industry conventions, including changes in rates of greater magnitude (e.g., up and down 300 and 400 basis points) across different tenors to reflect changing slopes and twists of the yield curve. Institutions should ensure their scenarios are* ***severe but plausible*** *[author's emphasis] in light of the existing level of rates and the interest rate cycle. For example, in low-rate environments, scenarios involving significant declines in market rates can be deemphasized in favor of increasing the number and size of alternative rising-rate scenarios.* [20]

Note the emphasis on the term "severe but plausible." This will come up in subsequent sections.

1. Yield Curve Shifts. It is clear from the FFIEC Advisory on IRR that the standard regulatory test is just the first step in the IRR management process. It is only one of an infinite number of yield curve shifts that could occur. It is infinite because the starting point, direction, magnitude, timing, and duration of those changes along with their relationship to other rates are always different. This means that virtually every major shift in market rates will itself be unique.

Rates on most of the financial products of depository institutions are driven by short- and intermediate-term rates, especially the fed funds rate and prime rate. However, fixed-rate 30-year first mortgage rates are driven primarily by the 10-year Treasury rate. This is important because as shown in Figure 1, short rates are far more volatile than long rates. [21] Although in an unpredictable manner, this relationship between short and long rates is contrary to the parallel rate shift assumption underlying the standard NEV tests. This unpredictable behavior is the very reason standardized tests are necessary.

Referring back to Figure 1 once again, consider what happened from mid-2004 to mid-2006, a period of 24 months. Short rates increased 425BPs but note that the 10-year Treasury rate and the rate on 30-year fixed-rate mortgage loans were relatively stable, fluctuating only about 50 basis points throughout most of this period. Thus, the yield curve flattened. In other periods of rising rates, the 10-year rate and fixed-rate mortgage loan rates moved roughly 50% of the movement in short rates. Correspondingly, when short rates decrease, the curve usually steepens as long rates decline at a slower pace. This differential movement in rates is known as *basis risk* and it is the main reason different scenarios should be tested periodically. The recommended tests are flattening, steepening and, when rates are at unusually low levels, sharper increases in rates such as +400 or +500BPs. Earning power performance can vary dramatically and surprisingly from one scenario to another. The key here is that scenario testing should be *"severe but plausible"* as cited by the FFIEC.

2. No Rate Change Scenario. Although the primary focus of scenario testing is usually on rising rates, another test that may be conducted is a multi-year, no rate change test using income simulation. In an extended, low-rate environment such as that characterized by the 2008-11 period, this analysis can be quite revealing. The problem arises when current market rates on loans and investments are lower than the portfolio yields. This scenario will show how earning power can deteriorate in a multi-year context as

[20] Federal Financial Institutions Examination Council, *Advisory on Interest Rate Risk Management,* January 6, 2010, p 5.

[21] The historical volatility relationship between short-term and long-term rates broke down in December, 2008 when the Federal Reserve targeted short rates to remain stable within a range of zero to 0.25% for an extended period.

loan yields decline due to runoff and prepayments, and maturing, amortizing or called investments are redeployed at even lower rates.

The normal antidote for this problem is to lower the cost of funds. But this strategy has limits as deposit rates decline and approach zero for many products. The result may be future margin pressure that is only revealed in an extended multi-year income simulation. It cannot be detected by an NEV analysis. This problem became more pronounced in August 2011 when the Fed indicated that it was likely to maintain its near-zero interest rate policy until at least mid-2013. The Fed followed this up in September when it announced it was going to attempt to drive down long-term rates in "Operation Twist." These policies have important implications for depository institutions already dealing with margin pressure from historically low interest rates and asset returns declining faster and more than the cost of funds as the latter begins to reach its lower limit.

3. Ramped vs Immediate Shock Testing. Another aspect of scenario testing is the manner in which changes in market interest rates are transmitted to the balance sheet for income simulation purposes. Since it is unlikely that the Fed would ever raise short rates 200 or 300BPs in one day it makes no sense to model such behavior. Remember, the modeling must be *"severe but plausible."* Referring back to Figure 1, note that during a period of changing rates they increased over time so it makes sense to ramp significant changes over some reasonable time frame such as 12 months for 200 or 300BP tests or 18 to 24 months for 400 or 500BP tests. This is where judgment comes into play along with some common sense. An added advantage of using the ramped procedure is that the results are far more credible to risk managers and directors rather than being summarily rejected as is often the case with unrealistic, immediate shock tests.

4. IRR & Credit Risk. Once again, it is important to stress that income simulation projections are not forecasts of income in an accounting or budgeting sense. Rather, the results indicate the extent of stress on core earning power and capital that could result from a change in interest rates and its effect on the *existing* balance sheet playing out over time. Also, these income analyses reflect only the impact of changing interest rates, not interactive effects that could compound the IRR problem. For example, a *gradual* increase of say 200 or even 300 basis points in rates may have a minimal impact on credit quality. However, an increase of 400 or 500BPs could increase the risk of default and thus loan losses from variable-rate loans and balloon loans, both of which are now standard products in modern depository institutions. By shifting IRR to borrowers, latent credit risk may emerge due to payment shock when rates increase significantly.

Ordinarily, IRR and credit risk are independent. However, in a severe interest rate stress test such as +500BP, and to the extent that this form of credit risk may be present—another judgment issue—an increasing loan loss provision expense could be simulated over the 5-year horizon in a "what-if" to examine the combined impact of increasing loan losses and IRR on earning power and regulatory capital.[22]

B. Non-Maturity Deposits (NMDs)

Since NEV is a valuation approach, a vexing implementation problem arises when valuing checking, savings and money market accounts, collectively known as non-maturity deposits, or NMDs. As the term

[22] Industry statistics indicate that even in normal interest rate environments, delinquencies and foreclosures on ARM loans are higher than the corresponding figures for fixed-rate mortgage loans. In the late 1970s and early 1980s variable-rate loans were virtually non-existent so there was little in the way of precedent as far as how these loans would perform from a credit standpoint in the event of a significant and sustained increase in rates. Common sense suggests that under certain conditions IRR and credit risk could interact in an adverse way.

implies these accounts do not have a specified maturity. The funds in these accounts are immediately withdrawable at the discretion of the depositor so on this basis, some argue that they should be valued at book value, or par in an NEV analysis. When valued in this manner these accounts provide no benefit to the institution in an NEV analysis and in fact, this valuation procedure may *overstate* IRR. The withdrawable feature is misleading because NMDs *collectively* behave as if they are long-term deposits. This is important because when combined with other attributes, the longer, theoretical maturity *may* be a risk-reducing characteristic that is ignored when NMDs are valued at par in an NEV analysis. As such, NMDs may provide a degree of protection against rising rates.

Recall that fixed-rate mortgage loans fall in value when market rates increase but this can be offset by liabilities that have long maturities and fixed rates, such as CDs or NMDs that pay no interest or reprice slowly and lag the market. Thus, NMDs with certain attributes can be valuable risk-reducing deposits that must be properly evaluated when assessing IRR.

The effectiveness of NMDs as risk-reducing liabilities depends on the interaction of three factors: 1) the assumed average maturity (or its counterpart, the so-called decay rate); 2) the speed of responsiveness or the lack thereof to changing interest rates; and 3) the cost of the deposits plus their servicing cost relative to their replacement cost.[23] As summarized below, these attributes must be thoroughly understood in the NMD modeling process since they determine the degree of risk mitigation.

1. Average Maturity (or Decay Rate). NMD history can be analyzed to determine the extent to which they "decay" or run off over time as depositors leave the institution due to relocation, a job transfer, retirement, death, dissatisfaction with service and so on. The estimated decay rate corresponds to an average maturity as the accounts decline over time through normal attrition. For example, a decay rate of 20% corresponds to an average maturity of 5 years; a 10% decay rate corresponds to a 10-year average maturity. A necessary, but by itself insufficient condition for risk mitigation is a long average maturity.

2. Responsiveness to Changing Rates. If a liability responds quickly and in a manner commensurate with changing interest rates such as a money market account, it will offer very little risk mitigation regardless of its average maturity because it will function like a variable-rate product. Its value will remain around par regardless of changes in external interest rates and regardless of the assumed average maturity. However, if it is slow to reprice and it lags the market like most savings accounts, these features will provide IRR mitigation when combined with a long average maturity assumption.

3. Cost vs Replacement Cost. A final ingredient in valuing the NMDs is their cost to the institution plus the related servicing cost relative to the cost of replacing those deposits. For example, in more normal rate environments unlike that of late 2011, if a savings account has an all-in cost of say 2% when the market rate or replacement cost for comparable average maturity funding is 3%, this is beneficial to the institution and adds economic value, especially in a rising rate environment. When this attribute is combined with a long average maturity and a slow response to changing rates, significant risk mitigation may be achieved in the valuation process. The extent of mitigation depends on the difference between the replacement cost and the cost to the institution in concert with the assumed average maturity and responsiveness to changing rates. The replacement cost for comparable average maturity funding is the discount rate used in the valuation process. A commonly used discount rate is a comparable FHLB funding cost. The beneficial effect of a long average maturity as discussed above is further augmented by the correspondingly higher discount rate associated with the longer average maturity.

[23] The OTS estimated these servicing costs as follows: 1.80% for the checking accounts, 1.39% for savings accounts, and .86% for money market accounts.

4. Risk Mitigation of NMDs. Against this background the risk mitigation effects of the three primary NMDs can be summarized, at least in general.

- Checking Accounts. These accounts often have significant risk mitigation potential. They are widely recognized as longer term deposits since they are transactional rather than rate-driven. These accounts usually pay no interest or a very low rate so they tend to be insensitive to changing interest rates unless they are "high rate" accounts that attract rate-sensitive deposits. Depending on the assumed average maturity, the replacement cost of traditional checking accounts historically has been higher than the rate paid on such accounts plus their servicing or non-interest cost. This spread tends to increase in a rising or high-rate environment thus increasing the value of these deposits to the institution. These accounts are also "sticky" due to electronic debits and credits, home banking, and mobile banking, all of which deter switching or even chasing rates. Research shows that these accounts tend to have average maturities ranging from 5 to 10 years. When such average maturities are combined with a correspondingly high replacement cost, or discount rate, these accounts can be risk-reducing in an NEV context.

- Savings Accounts. These accounts usually pay low rates that lag the market when rates increase, and in general, they tend to have a low degree of sensitivity to changing interest rates if a money market account and CD program are in place. Typically, their replacement cost is higher than the offering rate plus the servicing cost on this account. When coupled with long estimated average maturities, these accounts have risk-reducing attributes. However, if a high rate is paid, this reduces the effectiveness of these deposits in mitigating risk.

- Money Market Accounts. If these accounts consistently pay a competitive market rate and adjust quickly to changing rates (i.e., short lags), they will function in a manner similar to a variable-rate product. As such, these accounts will not decline materially in value in a rising rate environment so IRR mitigation is minimal at best and a long average maturity assumption contributes little to risk mitigation. However, if a below-market rate is paid, rate increases are delayed, and they respond only partially to rising rate conditions, these MMAs will provide some NEV benefit.

NMD accounts typically make up 40% to 70% of the liability side of the balance sheet of depository institutions so they are critical components of an ALM analysis. Their effectiveness in risk mitigation can vary considerably depending on assumptions regarding longevity, the manner in which management responds to changing interest rates, and the NMD cost relative to replacement cost. Judgment plays a key role in this process.

5. NMDs—Some Caveats. The NEV is an effective risk assessment tool when the balance sheet components have reasonably well-specified contractual features. Loans, investments, deposits and borrowings often have an option allowing a borrower, depositor or creditor to prepay a loan, call a bond, prematurely withdraw deposits, or even force repayment of debt. Although this optionality is pervasive on the balance sheet of financial institutions, it is nevertheless easy to estimate the NEV and income effects under various rate scenarios due to the specified contractual features or behavioral evidence available in the financial markets such as prepayments on mortgage loans. However, when applying the NEV approach, NMDs are subject to a wide range of assumptions about their behavior and thus their theoretical value. This can cause two similar balance sheets to be assessed very differently in an NEV analysis when using the NMD valuation approach.

As pointed out above, NMDs *collectively* behave as if they are long-term deposits even though on an individual basis they are immediately withdrawable. Using an actual, historical average maturity of 5 to 10 years (or even longer) for checking and savings accounts typically causes the shocked NEV ratio to improve dramatically and appear to mitigate risk. This is because their theoretical, long average maturities may cause the NMD account value to decline in a rising rate environment and offset a corresponding decline in asset values thus protecting capital on a market value basis. The extent of NEV improvement depends on the size of these accounts and the attributes discussed above, especially the average maturity and responsiveness to changing rates. However, there is no uniformity in estimating procedures nor is there a regulatory safe harbor in making NMD assumptions so NEV results can vary considerably from one institution to another even if they have identical balance sheets and IRR.

Although different analytical techniques have in general verified the beneficial long-term nature of NMDs, they contain an *embedded but undefined option* for savers to withdraw the funds in a manner that may not be reflected in historical decay analyses. This could be especially problematic if the future environment turns out to be unlike the past.[24]

The valuation problem this creates is somewhat analogous to a callable bond on the asset side. To see this, consider a new 5-year bond issued at par and callable in one year. If market rates increase significantly relative to the coupon, the bond will be valued more in line with a 5-year bond; if rates decrease, it will tend to be valued more like a 1-year bond. This optionality is easy to model under stress tests since the contractual features of the bond define the boundaries of the problem. NMDs on the other hand historically behave as if they are long-term deposits but there is no contractual maturity and the withdrawal option can be exercised at any time. Thus, there are no contractual boundaries for the NMDs.

Under certain conditions, valuing NMDs assuming long average maturities may *understate* IRR. In the event of a 1980s-style liquidity crisis, this undefined option to withdraw funds may be exercised in a disruptive way that may not be reflected in the long average maturity assumptions sometimes used in the NMD valuation process. To value NMDs at their historically long average maturities may ignore the possibility of a so-called "black swan" event. However, *this embedded but undefined option can be effectively nullified or its adverse effect minimized if the institution has a sound ALM position with a relatively low degree of IRR such that the institution can afford to pay significantly higher deposit rates in a rising-rate environment. This capability must be assessed using income simulation.*

Admittedly, these black swan events are rare and unpredictable but they have devastating consequences. Protecting the institution against such an event is one of the primary objectives of an ALM analysis in the first place as the S&Ls discovered in the early 1980s.

From the history of S&Ls, the ALM simulations conducted in this paper, and the contingency funding stress tests, we know that the counterpart of a high-risk balance sheet is a potential liquidity problem. This means that from an ALM standpoint, a high-risk institution or one that has an unusually high proportion of its liabilities in NMDs must be especially careful when specifying NMD valuation assumptions to estimate their theoretical values. Inappropriate assumptions can mask IRR and liquidity risk. To the extent that the NMD valuation procedure produces unusually favorable NEV results, it becomes critically important to confirm the risk implications by thoroughly analyzing the income simulation results as we did in the S&L analyses presented earlier. In practice, there can be surprising conflicts. Once again, sound judgment plays a key role in this process.

One final caveat is in order regarding NMDs. As shown in Figure 1, interest rates have been at historically low levels since 2008 and they are now expected to remain at these levels for several more

[24] As George Will said, "History always repeats itself, until it doesn't."

years. This is a result of the Great Recession and Federal Reserve monetary policy. This policy was reinforced at its August 2011 meeting in which it stated that current economic conditions "are likely to warrant exceptionally low levels for the federal funds rate at least through mid-2013."

In a subtle way this policy elevates the modeling risk associated with assessing the risk mitigation attributes of NMDs, especially in those institutions whose NMD accounts are large and growing. The longer the low-rate environment persists and NMDs grow due to the lack of a yield incentive to tie up funds in CDs, the greater the likelihood that the embedded but undefined option to withdraw the rate-sensitive funds from these accounts will be exercised in a rising rate environment. To the extent that this increased risk is present, it is unlikely to be reflected in an NMD longevity analysis. It could, however, manifest itself unexpectedly in a rising rate environment when rate incentives return to the market. Thus, notwithstanding the historical longevity of NMDs, it may be advisable to use a shorter average maturity in order to provide a *margin of safety* or allow for what could prove to be model error.

C. Policy Issues, Conflicts, & Measurability

Since the primary regulatory focus has been on the NEV and to a lesser extent, the change in the NII, IRR policy guidelines must reflect these measures. But there are several other issues with which management must contend. A risk guideline on the extent to which the Net Income (NI) can decline in a particular shock test may seem reasonable but it should *not* be implemented. In addition to the NII, the NI is determined by the interaction of fee income, operating expenses, and the provision for loan loss expense. To see the problem, assume IRR and loan losses are "normal" and the ROA is 1%. If loan losses increase such that the ROA declines to .20%, even a small increase in interest rates could wipe out the low .20% ROA. This would show a dramatic percentage decline in the NI and thus an IRR policy violation when the root cause was credit-related.

It is generally assumed that the NEV (or NPV) and income simulation approaches will show consistent results. This is usually—but not always—the case. They can show conflicting results when certain circumstances are present. Consider an actual situation in which an institution has relatively low capital ratio at just over 7%, a high concentration of fixed-rate 30-year mortgage loans and no substantial offsets on the liability side such as long-term CDs. The NEV analysis shows a significant decline in the Post-Shock NEV in percentage and basis point terms due to the large holdings of mortgage loans and its relatively low capital ratio. However, this institution has a large interest-bearing checking account paying a relatively low rate and it consistently maintains a high proportion of assets in the form of rapidly repricing investments in overnight funds and very short-term investments.[25] Thus, the income simulation results show that the NII and NI would *increase* in a +300BP environment. This is contrary to what would be expected given the NEV results. In contrast to the low shocked NEV, this indicates that the institution has a low degree of IRR due to the rapid repricing of a significant portion of its assets in investments. This rapid repricing offsets the lack of repricing of the mortgage loans when rates increase. (A large HELOC program tied to the prime rate would perform a similar function.)

In conflicting cases such as this, the income implications of a low shocked NEV should be augmented by an income simulation analysis and those results should be given considerable weight. However, this particular situation could change dramatically and quickly to a high-risk profile in income simulation if the overnight funds and short investments were suddenly redeployed into more mortgage loans or long-term investments. Such a change in strategy should be modeled prior to implementation. Once again, judgment is necessary in assessing such a situation. If the short-term investment strategy is on-going, the

[25] Because of uncertainty regarding the longevity of the checking accounts, they were valued using both their theoretical NMD value and at par. The latter approach ignored possible risk mitigation effects. However, in both cases the shocked NEV was quite low.

low shocked NEV ratio and favorable income simulation results may be acceptable but staying in compliance with ALM policy guidelines when there are conflicting NEV and income simulation results could prove to be problematic.

As pointed out earlier, for informational purposes ALM analyses should periodically include yield curve shifts other than parallel. However, guidelines in an IRR policy should pertain to a standard, parallel test rather than a unique, one-of-a-kind yield curve shift. Therefore, when producing non-parallel yield curve shifts, the results should *not* be compared to policy guidelines that relate to a standardized test.

In addition to possible inconsistent risk measurement results, a related issue is the actual measurability of IRR. In certain situations the results of a quantitative risk assessment may be so suspect that they are rendered unreliable. This complication can arise from several sources as summarized below:

- An unusually large savings account. Such an account and the lack of a separate money market account (MMA) is likely to have commingled, non-rate sensitive and rate sensitive balances that in effect, sensitize the entire account. This is due to the fact that in a rising rate environment the rate must be raised on all the funds in order to retain the rate-sensitive balances.[26] Although the presence of tiers may mitigate the IRR problem somewhat in a rising rate environment, the potential liquidity problem remains.

- A large CD program with very low or no early withdrawal penalties to act as a deterrent. From an ALM standpoint the objective of a CD program is to lock in the funds for a specified period of time and lock in the cost over that period. In the absence of a reasonably effective deterrent in the form of such penalties, one or both objectives may be violated and the risk of a liquidity and income problem is increased. The magnitude of this risk may be unknowable depending on the size of the program.

- A large CD program with extensive optionality. Such programs include those with so-called "add-in" or "bump-up" features. CDs with these options may violate the objective of locking in the cost for a specified period.

Although estimates may be made in an attempt to evaluate these effects, materiality is the primary determinant in assessing the reliability of the resulting risk metrics in these situations. Once again, judgment comes into play.

D. Qualitative Component of ALM

This paper has focused on the quantitative aspects of risk assessment and the role of judgment. However, there is an important qualitative component that must be considered as well. This encompasses the ALM policy, a well-functioning ALM Committee (ALCO) with detailed ALCO minutes, on-going ALM training, and the integration of IRR management with the strategic plan of the organization. This is the "people side" of the ALM process.

[26] In such cases, estimates of the rate-sensitive balances are often made based on the size of the individual accounts. If these accounts make up a significant portion of the liability side of the balance sheet, the potential for measurement error is correspondingly increased. The key point is that such balances may not fit nicely into known or measurable buckets representing their rate-sensitivity. From a modeling standpoint one approach to minimize the risk of this measurement error is to assume a higher degree of rate sensitivity for the entire account.

If an institution has what appears to be a low degree of interest rate risk but the qualitative component of the ALM process is weak, this may cause examiners to lack confidence in the quantitative component of the process. Conversely, an institution with a higher risk profile may be viewed more favorably if the ALM process is characterized by a well-trained staff, strong analytics, board and ALCO oversight, sound policies and proper controls.

E. Sensitivity & "What-If" Analyses

Since ALM is a forward-looking process it involves making estimates of future managerial rate-setting behavior and numerous other modeling inputs as they relate to future interest rate scenarios. Like all estimates they are subject to errors, some more so than others and some more material than others. Also, for some aspects of the ALM process there are no "correct" or verifiable inputs. The issue is often one of "reasonableness."

In the case of NMDs, the valuation inputs and assumptions may have a significant impact on the overall risk assessment as pointed out above. Thus, it is essential to determine the sensitivity of these inputs to normal measurement error or a fundamental change in that product relative to its history. A long average maturity and the corresponding discount rate assumptions are often the inputs that have a significant and positive impact on the NEV results. Bear in mind that these inputs are estimates *and* we are dealing with theoretical values rather than actual values.[27] The resulting values are opinions, not facts. Things can change and put the institution at risk. This is why risk managers should consider building in a *margin of safety* into estimates to account for possible errors that are present with any estimate. A sensitivity analysis is one way to address this issue.[28] As pointed out above, the NEV results should be confirmed by an analysis of the income simulation results which are unaffected by the NMD average maturity assumptions.

As discussed earlier, when new strategic initiatives or expanded lines of business are being considered, a "what-if" analysis should be run for various levels of activity in order to determine the IRR effects and possible concentration limits on those products. Such exercises integrates the ALM process with the strategic plan of the organization.

F. Outsourcing

Many institutions outsource their ALM modeling due to the lack of time, staffing, or expertise. However, it is becoming increasingly clear that they will be held to the same standards as those that perform this process in-house. But due to the lack of internal, hands-on learning in the modeling process, the task of learning and actually implementing the ALM results in the decision-making process may be more difficult. Increasingly, regulators are requiring a far more thorough understanding of ALM modeling, the underlying assumptions, policy formulation and strategies. Initial and on-going ALM education for management and directors is now an essential part of governance because the responsibility for developing an effective ALM process cannot be outsourced to a third party.

VI. CONCLUSION

The IRR problem now confronting depository institutions is extraordinarily complex. With interest rates at historically low, manipulated levels the stage may be set for a period of financial stress due to rising rates. In this regard, the lingering effects of the S&L crisis hang over depository institutions like the

[27] As Yogi Berra reportedly said, "In theory, there is no difference between theory and practice. In practice, there is."

[28] Such an analysis is expected to be performed by credit unions pursuant to Letter 03-CU-11.

Sword of Damocles. Even if rates only return to "normal" levels, some institutions may suffer a decline in earning power. However, others may perform quite well due to a high degree of liquidity as a result of slack loan demand with those funds shifting to short-term investments due to the fear of rising rates.

To further complicate matters, if the Federal Reserve continues to maintain interest rates at unusually depressed levels for an extended period as it has indicated in its recent policy pronouncements, the net interest margins of most institutions may be under intense pressure because of diminished capacity to generate sufficient interest income and further reduce the cost of funds. The dilemma this creates is the temptation, or perhaps the need, to extend maturities on the asset side at what may prove to be the worst time in history. Hence, the measurement and management of IRR takes on added importance.

As this paper has demonstrated, there are many facets of the IRR measurement problem. There is no single "black box" number nor is it always an unambiguous pass/fail situation. Rather, there are multiple and closely related measures that usually, but not always, provide consistent signals regarding IRR. These signals must be properly interpreted by developing and examining complementary and related quantitative metrics and placing them in their proper context.

In this regard, both an NEV analysis and an extended, multi-period income simulation analysis are necessary to accomplish this objective. The shocked NEV is a single, all-inclusive number that must be augmented by examining the manner in which it is affected by changing rates. That is, the % change and the basis point change must be related to capital. But the NEV methodology has limitations. It does not focus explicitly on income performance or its impact on regulatory capital as shown in this paper. Furthermore, the NEV may be significantly affected by underlying NMD assumptions. Finally, it provides little or no income-related insight in a stable or falling rate environment. For these reasons, such an analysis must be augmented by an extended, multi-period income simulation that adds considerable context by explicitly showing the potential severity of the income problem, the timing and speed of income recovery or the lack thereof, and the projected impact on regulatory capital. As stressed repeatedly, judgment plays a key role in this assessment. Furthermore, the quantitative aspect of the ALM process must be augmented by a strong qualitative component with proper training, controls, and governance.

Inaccurate IRR assessments have led some institutions to unknowingly assume too much risk and others to assume insufficient risk. Furthermore, there is justifiable regulatory concern that institutions may be increasing their IRR in an attempt to offset the income pressure from an elevated level of loan losses, margin compression, weak loan demand, and historically low investment yields. Accordingly, it is imperative that this risk be properly measured and assessed to allow institutions to not only fulfill their economic role, but to survive as well.

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