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REPORT

Asset-Liability Management: Theory, Practice, Implementation, and the Role of Judgment

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Foreword by Harold M. Sollenberger, Professor Emeritus, Michigan State University

Acknowledgments

Most research involves the collective efforts of numerous individuals who should be recognized. This report is no exception. First, Ben Rogers of the Filene Research Institute was instrumental in encouraging me to weave the various components of a complex topic—asset-liability management—together into a single readable and reasonably comprehensive source. Ben's goal was to meet what he correctly perceived as a pressing educational need in light of new regulations, one of which requires a certain level of financial knowledge for directors.

To lay the groundwork for this research, the staff at Brick & Associates, Inc., conducted numerous risk assessments and analyses of the savings and loan (S&L) industry as it existed in the late 1970s, just prior to its collapse due to rising interest rates in the early 1980s. This analytical work was followed up continually with helpful comments, suggestions, and criticism of the many drafts and earlier research underlying the report. I am most grateful to Krista Heyer, Kerry Brick Zsigo, Bridget Balesky, and Jeff Brick for their insight and significant contribution to the literature on interest rate risk management. Finally, the comments and suggestions of the Filene reviewers and editors took the report to yet another level, for which I am also grateful.

Filene thanks its generous supporters for making this important research possible.

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

TABLE OF CONTENTS

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Table of Contents

Foreword

by Dr. Harold M. Sollenberger
Professor Emeritus, Michigan State University

Assessing interest rate risk (IRR) within an asset-liability management (ALM) policy is a central consideration of nearly every financial decision made and action taken by credit union executives. This report first provides history of the impact of interest rates on financial institutions over more than three decades, with the author's personal perspective of "I have lived through all of that" and his well-versed knowledge of financial markets both in theory and in practice. Then, Jack Brick moves into his true area of expertise—showing credit union managers how to analyze IRR issues, how to build an effective ALM policy, and how to implement it to lead their credit unions.

Jack has written about financial management issues for his entire academic and financial advising career. He brings a unique combination of academic research tools; pragmatic experience in advising large, small, and very diverse credit unions on ALM issues; and an aggressively conservative approach to "winning" in the financial marketplace. Winning in this sense includes managing through difficult times, surviving, and producing a financially strong and successful credit union for its members' benefit.

Managing IRR, along with the other dominant risk—credit risk—largely determines the success or demise of a credit union in often subtle but, at other times, very direct ways. Yes, other risks exist in financial institutions that must be contained and overseen in order to give an institution a competitive advantage. Over the years, financial analysis has developed packages of ratios in each risk area—except for IRR. Ratios can be developed from historical financial statements and projected into the future to identify weaknesses, strengths, and potential trouble spots for credit, liquidity, capital adequacy, earnings, and growth risks. But no such set of magic calculations has been found to do the same for IRR.

Interest rates have forever gone up and down. Changes in rates have had significant impacts on financial institution earnings, have caused other risks to rise and diminish, and can have dramatic impacts on decision making. Controlling interest rate movements, their impacts, and their magnitude, direction, and rate of change has been central to national economic policy, political debates, government controls, and business sector decision making since borrowing and lending began. Yet, the actual analysis of

IRR is a relatively new science—for the first time appearing seriously in the mid-1980s. Even today, many arguments exist as to how to define, measure, and use the resulting analyses to manage IRR arising from current rate structures and from predicted future interest rate changes. New tools and capabilities exist now that only a few decades ago were clearly outside the reach of financial managers and policymakers. Computer hardware, databases, modeling software, and other stronger research tools combine to give the industry much better capabilities to attack IRR at a much more sophisticated and disciplined level. Jack examines these approaches here.

Putting this newly developed knowledge to work in a coherent framework in a credit union is still a daunting task. The good news is that the author of this report has a sense of theory, a knowledge of what works and doesn't work in the real world, and common sense to judge the world around him soundly.

I have known Jack Brick for well over a quarter century—first as a colleague on the Michigan State University accounting and finance faculty, then as a fellow teacher in numerous credit union financial management programs, as a go-to person when I (as an academic) had a "how is it really done" question, and as an active board member of my credit union, the Michigan State University Federal Credit Union.

Jack has strong academic research training. He worked in the financial services business prior to his academic stints. He now heads a successful consulting business, working primarily with credit unions across the country. I have heard many of his clients sing praises about the quality of his firm's work, his integrity, and his astuteness about markets and how to assess the risks and opportunities these clients face.

In this report, Jack brings together many of his writings in ALM and talks about how to use various tools to manage the balance sheet. He discusses asset pricing, mix issues, policy guidelines, reporting practices, setting financial management priorities, and validation of the process itself.

Change is constant, and ALM must change as markets, products, and personnel change. Underlying the author's approaches and concepts is the assumption that a credit union has quality people—well trained, disciplined, and with sufficient ALM experience to handle both expected and unexpected changes. The ALM job is not simple, nor is it window dressing. It is a key managerial task. This report stresses that point from beginning to end.

Executive Summary

Overview

Evaluating interest rate risk (IRR) will remain a chief priority for credit union executives, especially when enforcing an effective asset-liability management (ALM) policy. Credit unions should identify pressing IRR issues and implement solutions that will allow them to withstand volatility related to periods of rapidly rising interest rates.

MEET THE AUTHOR

John R. Brick
Brick & Associates, Inc.

When the S&L industry ran into jackknifing interest rates in the late 1970s and early 1980s, its fixed-rate mortgage-heavy balance sheet was ill prepared. You know how that story ends.

Coming out of a different recession, credit unions are in a much better structural position to weather the coming rise in interest rates, with only 25% of assets hitched to long-term mortgages, and a much healthier mix of checking, savings, and money market products funding those assets. But regulators have learned their lesson, and individual institutions' directors and managers are responsible for ALM by understanding and modeling their own IRR. As products proliferate, portfolios grow, and examiners watch, credit unions need to know their risks and set sound policies.

What Is the Research About?

Different perspectives and risk tolerances between credit union practitioners and credit union examiners mean that both groups take different approaches to analysis and policy. Generally speaking, examiners seek practices that minimize IRR as much as possible and may ask for analysis and policies that credit unions consider unrealistic. Credit unions seek to understand and mitigate IRR but do not always agree with the demands imposed by examiners. This research seeks to balance the priorities of both by placing ALM in historical perspective and outlining the variables that dictate its current practice.

The full report provides a comprehensive review and operational insights for both financial professionals and the directors who oversee them. In recent years, the author's firm prepared a number of separate papers focusing on specific aspects of the ALM process. This report is both a compilation and an extension of those earlier efforts in a cohesive framework.

What Are the Credit Union Implications?

After reaching record levels in the early 1980s, interest rates then entered a prolonged stretch of declining rates spanning over three decades. There were relatively short periods when short-term rates increased 200 to well over 500 basis points (bps). However, with the exception of those occurring in the early 1980s, these increases were not sustained. The resulting income pressure due to the high levels of IRR was short-lived, and relief was quickly forthcoming as rates declined. Thus, credit unions did not feel

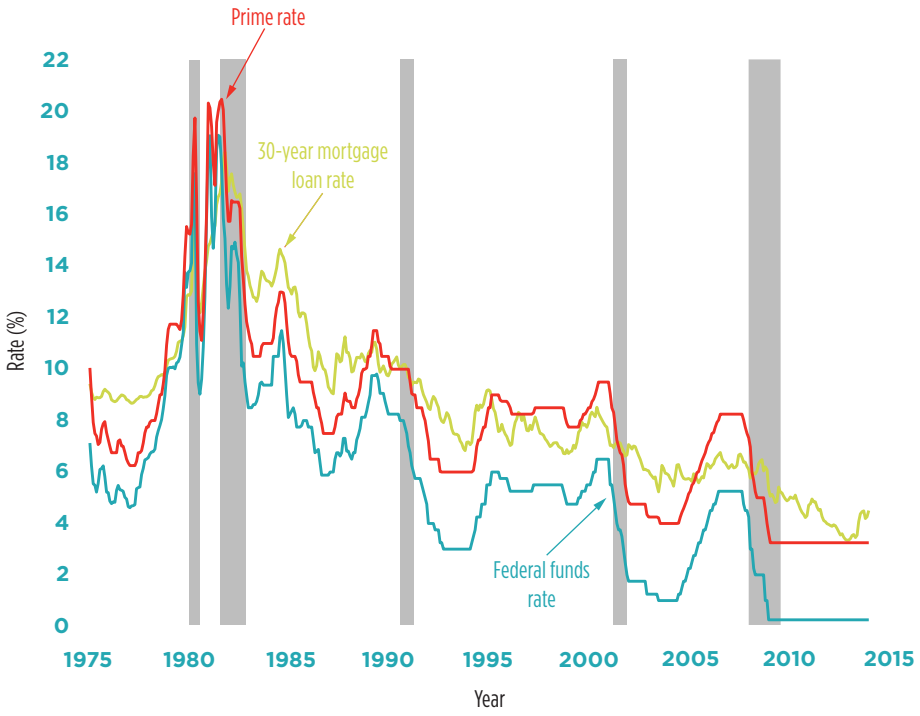
the full and potentially devastating effects of these episodes. This means that despite a much better understanding of IRR and more powerful analytical tools, financial institutions have not been tested in a prolonged period of rapidly rising interest rates that have been sustained at a high level.

Three near-term possibilities will test credit unions' collective IRR: (1) a return to a more "normal" level of interest rates when the Fed ends its ultra-low interest rate policy, (2) a stronger economy and lower levels of unemployment and underemployment, and (3) increased inflation or inflationary expectations.

Other important considerations from the report:

- **Net economic value (NEV) and income simulation.** Using these approaches in tandem is healthy. A shocked NEV provides a single, all-inclusive statistic that captures complex relationships, including durations and embedded options. Income simulation over a

INTEREST RATES, 1975–2013



Source: St. Louis Federal Reserve Bank.
Note: Shaded areas represent recessions. The federal funds effective rate is shown for the period January 1975 to August 1982, and the federal funds target rate is shown for the period September 1982 through 2013.

three- to five-year period allows managers to forecast the effect of rate shocks while understanding the interplay of other factors, like operating expenses, loss provisions, and noninterest income.

- **Non-maturity deposits (NMDs)**. One of the shortcomings of NEV analysis is that it depends heavily on assumptions for valuing NMDs, which are subject to immediate withdrawal but which, in aggregate, act like long-term deposits. NMDs may provide a degree of protection against rising rates, but credit unions should understand the historical behavior of their own NMDs and fully understand the assumptions embedded in any ALM analysis of those deposits.
- **Systemic risk**. Changes in regulations and balance sheet structures mean that the credit union system of 2014 is far less risky than the S&Ls of the 1980s. In the unlikely event that interest rates rise quickly to double digits, many individual credit unions would suffer, but the damage is unlikely to match the full rout suffered by S&Ls in the 1980s.

The key takeaway is the need for effective IRR management and building in a margin of safety in the ALM modeling process. To paraphrase a long-standing caveat in the investment community, past performance (in managing IRR) is not a guarantee of future performance.

Asset-Liability Management: Theory, Practice, Implementation, and the Role of Judgment

CHAPTER 1

Background and ALM Concepts

The purpose of this chapter 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 IRR 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 IRR provides one of the main sources of institutional compensation.

In the years following the financial crisis of 2007–9, IRR measurement and management took on added importance as net interest margins became compressed due to declining loan volume and historically low interest rates, especially on investments and variable-rate loans. Operational and regulatory costs increased along with loan losses and politically

motivated attacks on fee income. All of these factors put added pressure on performance. Regulators feared that some institutions were taking on excessive IRR in order to offset these pressures and improve current income, and thus they correctly believed that the low-rate environment itself posed a significant risk. As a result, federal examiners of depository institutions issued new guidance on IRR management. Furthermore, the National Credit Union Administration (NCUA), the regulator of federally chartered credit unions, released a new IRR management regulation in September 2012 that raised the stakes for credit unions.

The first step in the risk management process is to measure the 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, we will look at the historical background and review the root cause of the IRR management issue—the savings and loan (S&L) crisis of the 1980s and its prolonged aftermath.

Historical Overview of the IRR Problem

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 federal funds rate was 6.5% and the prime rate was 7.75%. As interest rates increased, both the federal 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 S&L industry was especially devastated due to its 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 legislation was to allow S&Ls to "grow their way out of the problem." In the years that followed, 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.

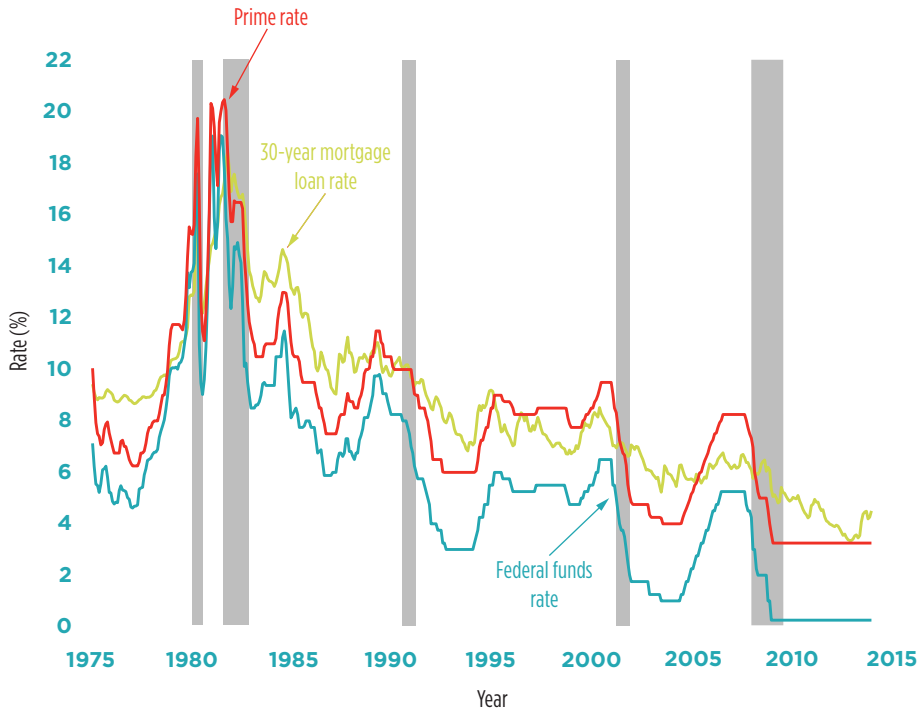
By the early 1990s, the failure of over 1,200 S&Ls reduced the industry by about one-third of its original size. This gave rise to the S&L syndrome that has haunted managers of financial

institutions and regulators ever since. (In Chapter 2 we will examine the S&L collapse in analytical detail with emphasis on IRR.)

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 in the next chapter, 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. This mandate may sound familiar.

FIGURE 1

INTEREST RATES, 1975–2013



Source: St. Louis Federal Reserve Bank.
Note: Shaded areas represent recessions. The federal funds effective rate is shown for the period January 1975 to August 1982, and the federal funds target rate is shown for the period September 1982 through 2013.

Regulatory Response

In the aftermath of this crisis, 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 sheets of depository institutions evolved into more complex structures with far more products and extensive optionality on both asset and liability sides. 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 were viewed as 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 Chapter 2, where we take 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. This is a critical point. It is insufficient to look just at fixed-rate mortgage loans as the primary or sole determinant of risk. The risk mitigants on the rest of the balance sheet—or the lack thereof in the case of S&Ls—must be examined as well. Rather than zeroing in 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.

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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. This helps both practitioners and regulators understand what the process is and, equally important, what it is not. Since the term "asset-liability management" is hyphenated, this provides an important clue. The narrow definition is as follows:[2]

> *Asset-liability management (ALM) is a forward-looking process involving the joint and 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 and those of liabilities. As pointed out earlier, this imbalance is a primary source of institutional compensation, along with the assumption and management

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. Additionally, 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 not only produced a devastating income problem due to the rapidly rising cost of funds relative to the fixed asset returns, but it also 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.

Analytical Procedures

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. 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, preventive action should be implemented. To achieve this objective, appropriate analytical procedures must be correctly applied. In this section, the most commonly used procedures—net economic value (NEV)[4] and income simulation—are examined along with their advantages, disadvantages, implementation issues, and misconceptions.

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. This difference is the capital (or net worth) expressed in terms of current market value or shocked market value rather than book value. Dividing the current market value of capital by the current market value of the assets gives a ratio 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 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 +300 bp shock test shown in Figure 2.

FIGURE 2

SIMPLIFIED BALANCE SHEET AND NEV ANALYSIS

		Market values	
	Book value	1. Current value*	2. Shocked +300 bps
Assets			
4-year 5% bonds	$100M	$100M	$89.9M
Liabilities			
1-year 2% CDs	$90M	$90M	$87.4M
Capital	$10M	$10M	$2.5M
Capital and NEV ratios	10%	10%	2.8%

*For simplicity it is assumed that the current market values equal the book values.

A casual look at this balance sheet shows a structural imbalance with four-year 5% bonds financed with one-year 2% certificates of deposit (CDs) and capital. But just how bad is this imbalance? Is the capital sufficient to support the risk implied by this structure? In order to answer these questions, the shocked NEV concept is applied. In a +300 bp shock test the value of the $100 million (M) in bonds falls by 10.1% to $89.9M, while the $90M in CDs falls 2.6% to $87.4M. This disparity causes 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 bps from the no-shock scenario.

Such erosion could be prevented by the following: (1) the assets (bonds) would have to be shorter in maturity and reprice sooner; (2) the CDs would have to be longer in 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. 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. Effective risk taking—whether it is credit risk or IRR—is the primary source of institutional compensation.

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, on 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, which will both exacerbate the income problem and, depending on the extent of that problem, accelerate the erosion of capital.

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 risk, i.e., its capital.

These issues may be addressed in several ways. 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 bps to the post-shock NEV of 2.8%. This procedure was used by the former Office of Thrift Supervision (OTS) and will be demonstrated below. The second way is to examine the percentage 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 percentage 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 rough proxy for determining liquidation value under stressful interest rate conditions.[7] Like the OTS approach, this procedure can provide an effective early warning of potential problems. However, in both approaches, extreme care must be exercised when interpreting the NEV results of institutions that have unusually low or high capital ratios. To see this, consider the comparison of three institutions shown in Figure 3.

FIGURE 3

RISK COMPARISON

	Institution		
	A	B	C
Pre-shock NEV	6%	10%	14%
Post-shock NEV	3%	5%	7%
% change	–50%	–50%	–50%
Basis point change	–300 bps	–500 bps	–700 bps

Note that the post-shock NEV for Institution A is only 3% versus 5% and 7%, respectively, for Institutions B and C. Looking at this in isolation might suggest that Institution A has the highest IRR because of its low post-shock NEV. But this is not necessarily the case. In fact, Institution A may have the *lowest* IRR. The basis point change between the pre-shock NEV and the post-shock NEV is only –300 bps for Institution A versus –500 bps for Institution B and –700 bps for Institution C. The percentage 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, Institution C has the highest IRR 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, Institution A may have the lowest IRR, but it also has the lowest risk-absorbing capability.

Whether measuring basis point change or percentage change, extreme care must be exercised when interpreting the NEV results of institutions that have unusually low or high capital ratios.

This simplified 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 percentage 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 percentage 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 percentage 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 Institution A, the post-shock NEV will also be low, perhaps misleadingly so, and may reflect IRR that is not present. Thus, it is important to distinguish between what may be a low-capital problem, as in Institution A; a potential IRR problem, as in Institution C; or a combination of both, as in Institution B. This is where judgment comes into play and additional risk measurement metrics must be utilized to make a reasonably definitive IRR assessment.

If Institution 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 multiperiod 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 a later chapter, can vary considerably from one institution to another. Against this background, it is now useful to examine the regulatory approaches to IRR measurement.

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 OTS, developed an IRR approach that was later applied to thrift institutions under its jurisdiction.[8] This model is shown in Figure 4.

FIGURE 4

OTS RISK MATRIX

Post-shock NEV ratio (+200 bps)	Basis point change in NEV ratio shocked +200 bps			
	0–100 bps	101–200 bps	201–400 bps	>400 bps
>10%	Minimal risk (1)	Minimal risk (1)	Minimal risk (1)	Moderate risk (2)
6%–10%	Minimal risk (1)	Minimal risk (1)	Moderate risk (2)	Significant risk (3)
4%–6%	Minimal risk (1)	Moderate risk (2)	Significant risk (3)	High risk (4 or 5)
<4%	Moderate risk (2)	Significant risk (3)	High risk (4 or 5)	High risk (4 or 5)

Source: Office of Thrift Supervision, Department of the Treasury, "Thrift Bulletin 13a, Management of Interest Rate Risk, Investment Securities, and Derivative Activities," December 1, 1998.
Note: 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 +200 bps. Depending on the intersection of the basis point change and the post-shock NEV ratio, the risk was defined by the modifiers as minimal, moderate, significant, or 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 system for thrift institutions.

This approach is sound in theory in that it attempts to evaluate risk in relation to the institution's ability 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 rules. As shown later, it was an effective early-warning stress test. Despite its more robust approach, the major drawback of the OTS methodology was 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.

NCUA Approach

The NCUA approach focuses on the post-shock NEV not breaching 4% in a +300 bp shock test *and* the percentage 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 percentage 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 to absorb not only IRR but *all* of the other risks embedded in that institution. Second, a low post-shock NEV may signal a shorter timeline than 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 NII can decline in a shock test from a base case. At one point, in a +300 bp test a decline greater than 30% in the NII was deemed to be "high risk."[9]

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 (MMAs) at par (or book value) because these deposits are immediately withdrawable. However, it is well recognized that these non-maturity deposits (NMDs) collectively behave like 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.[10] 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, which used short average maturities on NMDs in concert with its risk matrix.*

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. As with 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 components other than just the loan-to-value (LTV) ratio, 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.

An NEV analysis, to be most effective, should be supported by a complementary multiyear income simulation analysis. Together they provide the necessary income and capital context to both managers and regulators.

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

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.* In the next chapter, 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. This is derived

FIGURE 5

INCOME SIMULATION

	Year 1	Year 2	Year 3	Year 4
1. No rate change:				
4-year 5% bond interest income	$5.0M	$5.0M	$5.0M	$5.0M
1-year 2% certificate expense	$1.8M	$1.8M	$1.8M	$1.8M
Net interest income (NII)	$3.2M	$3.2M	$3.2M	$3.2M
2. Rate change: +300 bps				
4-year 5% bond interest income	$5.0M	$5.0M	$5.0M	$5.0M
1-year 2% certificate expense	$1.8M	$4.5M	$4.5M	$4.5M
Net interest income (NII)	$3.2M	$0.5M	$0.5M	$0.5M

Note: The NII generated by the no-rate-change scenario in Year 1 is the base against which NII changes are evaluated.

from the simplified balance sheet shown in Figure 2 and for which the corresponding NEV analysis was derived.

NII

Note that the focus is on the impact of changing interest rates on the NII rather than on the 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 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.

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.[11] 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.

An income simulation analysis does not forecast future income. Rather, it estimates 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 for a given change in interest rates. 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 also 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; thus, 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 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.*[12]

The 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. Concern about the ALM results changing over time due to changes in the balance sheet may be 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.

For every NEV analysis of an existing balance sheet, there is a related income stream; thus a shocked NEV and the corresponding income simulation results are two sides of the same coin.

This modeling procedure should not be confused with what-if modeling, in which the existing balance sheet is altered on a pro forma 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 Federal Home Loan Bank (FHLB) funding can be tested in a variety of ways for income and risk implications.

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 chapter, the S&L industry is analyzed using both NEV and a five-year income simulation horizon. The income results over this extended horizon provide compelling insight, perspective, and context that support and complement 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 pressure that changing interest rates can have on NI 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.

Critics of income simulation argue that it is not comprehensive enough because by focusing on short-term results, i.e., the next year or two, it fails to take into account longer-term balance sheet components like mortgage loans. This is a valid criticism, but it is easily resolved by extending the income simulation horizon.

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

In the next chapter, the NEV concept and income simulation will be brought together through 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.

CHAPTER 2

ALM Methodology and the S&L Industry—a Postmortem

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 bps (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 in Chapter 1, in the late 1970s and early 1980s, economic conditions changed as both interest rates and volatility increased dramatically. Swings of 5–10 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 chapter we will examine the S&L industry's collective balance sheet as of December 31, 1977, just prior to the unprecedented run-up in interest rates in the late 1970s and early 1980s. We will then analyze the industry's risk profile using contemporary analytical procedures.

The S&L Balance Sheet

The S&L industry's year-end 1977 balance sheet is shown in Figure 6. It is a straightforward structure. Residential mortgage loans (1 to 4 family units) made up 74.4% of assets, with

FIGURE 6

CONDENSED STATEMENT OF CONDITION, S&L INDUSTRY, DECEMBER 31, 1977

Assets	$(M)	% of total	Liabilities and net worth	$(M)	% of total
Cash and demand deposits	4,593	1.0	Savings deposits		
Liquid investments			Passbook accounts (5.00%)	146,742	32.0
Federal funds (6.50%)	4,593	1.0	Certificates (7.00%)	240,133	52.3
US Treasuries (7.00%)	25,149	5.5		386,875	84.3
Other investments (7.25%)	4,862	1.1	Borrowed funds		
	34,604	7.6	FHLB advances (7.50%)	19,952	4.3
Mortgage-related assets			Other borrowings (8.00%)	7,851	1.7
Residential loans[1] (8.96%)	341,690	74.4		27,803	6.0
Commercial loans (9.25%)	39,526	8.6	Other liabilities		
MBSs[2] (8.25%)	12,701	2.8	Loans in process	9,932	2.2
	393,917	85.8	Other liabilities	9,491	2.1
Consumer loans (8.00%)	10,287	2.2		19,423	4.3
Other assets			Net worth	25,181	5.5
FHLB stock	3,200	0.7			
Building, equipment, other	12,681	2.7			
	15,881	3.4			
Total assets	$459,282	100%	Total liabilities and net worth	$459,282	100%

Source: US League of Savings Associations, *Savings & Loan Fact Book*, 1978, p. 80.
Note: The rates shown in parentheses were the current market rates at that time and were either obtained from the St. Louis Federal Reserve Bank or estimated by the author.
1. 1 to 4 family units and apartments
2. Primarily passthrough securities

mortgage-backed securities (MBSs) 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 or their equivalent. The MBSs were mainly Ginnie Maes that could be used to meet the industry's 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.

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 three-year average life assumption was used in the three NEV analyses that follow in order to compute their theoretical value. Certificates, at 52.3% of Liabilities & Net Worth, were the other primary funding source. Note that there were no MMAs, as these came about several years later. Although it is a rate-sensitive product, the MMA is important in IRR management because it allows more effective segregation of rate-sensitive deposit 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.

The MMA is an important product for IRR management because it allows more effective segregation of rate-sensitive deposit balances from less rate-sensitive balances.

Some of the data necessary to conduct these analyses were not available in the *1978 S&L Fact Book*, which is the source of the balance sheet. Thus, estimates had to be made using published market rates at that time. Also, assumptions had to be made regarding the cost and maturity structures of CDs, FHLB advances, and other borrowings.[13]

Before analyzing the results, it is worth noting several other aspects of the S&L balance sheet. First, there were no variable-rate loans such as adjustable-rate mortgages (ARMs) or home equity lines of credit (HELOCs) at that time. The latter began in the late 1980s and have become 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. These accounts are an important source of stable, non-rate-sensitive funding.[14] 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.
- Provide an overall framework for the assessment of IRR.

ALM Analyses of the S&L Industry

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 NI and regulatory capital, estimates were made for future operating expenses (2% of assets), fee income (0.20% of assets), and provision for loan loss expense (0.15% of loans). These estimates are consistent with the operating results of S&Ls at that time. Income taxes were 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 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 an MMA at that time. Maturing debt is rolled over at market rates that increase by 100% of the rate shock, which was ramped over a 12- or 18-month period as indicated for income simulation purposes. Loan runoff and prepayments were assumed to be redeployed at rates that are increased by 50% of the rate shock.[15]

Scenario 1—OTS Model

The first ALM scenario applies the standard OTS test of a +200 bp 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, the projected income effects using a 12-month ramp have been added. As the results show in Figure 7, the basis point change is –678 (line A5b), and the post-shock NEV ratio is –1.30% (line A5d) in the +200 bp test.[16] On a market value basis, the capital of the industry would have been wiped out. As the OTS table in Figure 4 indicates,

FIGURE 7

SIMULATED PERFORMANCE OF S&L INDUSTRY, 12/31/77 OTS MODEL:
IMMEDIATE +200 BPS FOR NEV, RAMPED 12 MONTHS FOR INCOME SIMULATION ($M)

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. Basis point change from current NEV	–678					
5c. % change from current NEV	–121.75%					
5d. Shocked NEV ratio	–1.30%					
		Shocked +200 bps (12-month ramp)				
	No shock	Year 1	Year 2	Year 3	Year 4	Year 5
B. Projected % change in:						
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 income/average assets	8.33%	8.41%	8.56%	8.69%	8.81%	8.92%
2. Yield on average earn assets	8.79%	8.80%	8.96%	9.09%	9.22%	9.33%
3. Cost of funds	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)	0.74%	0.37%	–0.20%	–0.30%	–0.32%	–0.27%
6. Projected capital ratio at book value	6.18%	5.84%	5.64%	5.36%	5.06%	4.81%

this was clearly a high-risk position, to the surprise of absolutely no one. In fact, these results are literally off the chart.

Now consider the income simulation results. The NII (line B1) declines sharply from the projected NII in the no-shock scenario and 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, multiyear income simulation—it provides the necessary context that complements*

the NEV analysis by directly addressing (1) the estimated severity of the income problem, (2) the timing and speed of income recovery (or the lack thereof), and (3) the explicit impact on regulatory capital.

The estimated impact on regulatory capital is especially noteworthy. If rates are unchanged, the baseline return on assets (ROA) of 0.74% (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 (NIM; line C4) causes the projected NI 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 +200 bp shock test. In the past, S&Ls were able to recover from such events because they were not sustained as in this simulation. From this analysis, it appears that the only reason this industry did not fail earlier due to rising rates was because they quickly receded.

Scenario 2—NCUA Approach

The NCUA has primary regulatory jurisdiction over federally chartered credit unions. As pointed out earlier, its risk guidelines call for a post-shock NEV not to fall below 4%, with the percentage decline not to exceed 50% in an immediate and parallel shock test of +300 bps. But recall that these guidelines are based on NMDs being valued at par rather than at their theoretical value based on an assumed average life. 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 three-year average life will be used rather than par value. Therefore, the NCUA risk guidelines should not 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 in Chapter 4.) The results of this analysis are shown in Figure 8.

The post-shock NEV ratio in this case is –5.17% (line A5d) and the percentage change is –182% (line A5c).[17] 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 (1) rates remain at an elevated level for a sustained period, (2) income does not recover, and (3) 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.

FIGURE 8

SIMULATED PERFORMANCE OF S&L INDUSTRY, 12/31/77 NCUA TEST:
IMMEDIATE +300 BPS FOR NEV, RAMPED 12 MONTHS FOR INCOME SIMULATION ($M)

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. Basis point change from current NEV	–1,066					
5c. % change from current NEV	–182%					
5d. Shocked NEV ratio	–5.17%					
		Shocked +300 bps (12-month ramp)				
	No shock	Year 1	Year 2	Year 3	Year 4	Year 5
B. Projected % change in:						
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 income/average assets	8.33%	8.45%	8.70%	8.92%	9.13%	9.33%
2. Yield on average earn assets	8.79%	8.84%	9.11%	9.33%	9.55%	9.76%
3. Cost of funds	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)	0.74%	0.18%	–0.70%	–0.85%	–0.90%	–0.83%
6. Projected capital ratio at book value	6.18%	5.66%	5.00%	4.19%	3.33%	2.52%

In simulations involving an interest rate stress test, the near-term NII may decline, but within a few years it may 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 assessment and any other IRR assessment using income simulation is not only the extent of the NII decline but also the timeline and speed of its recovery. This requires an extended, multiyear 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 NI (line B2) is deep in the red in year 2 with devastating consequences for the statutory capital. The initial capital ratio at book value is 5.48% (line A2), and if rates are unchanged, the ROA of the S&L industry is projected to be about 0.74% (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 +300 bp 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 +300 bp shock. Also, note the precipitous decline in the NIM (line C4).

Scenario 3—Replicating Actual Events

Rather than focusing on the S&L problem in the context of regulatory testing processes, this ALM scenario attempts 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.

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 the graph of interest rates 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 +500 bps was applied on a ramped basis over 18 months. Unlike the prior analyses, the speed and magnitude of this rate shock were 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 life of CDs from 14.9 months in the base case to 12.5 months in the +500 bp shocked scenario. The results are shown in Figure 9.

The predictive capability of the combined NEV and income simulation approaches is readily apparent. The incredible decline in the post-shock NEV of 1,913 bps (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

FIGURE 9

SIMULATED PERFORMANCE OF S&L INDUSTRY, 12/31/77 REPLICATE ACTUAL EVENTS: IMMEDIATE +500 BPS FOR NEV, RAMPED 18 MONTHS FOR INCOME SIMULATION ($M)

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. Basis point change from current NEV	–1,913					
5c. % change from current NEV	–299%					
5d. Shocked NEV ratio	–13.65%					
		Shocked +500 bps (18-month ramp)				
	No shock	Year 1	Year 2	Year 3	Year 4	Year 5
B. Projected % change in:						
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 income/average assets	8.33%	8.46%	8.92%	9.35%	9.77%	10.18%
2. Yield on average earn assets	8.79%	8.86%	9.33%	9.79%	10.23%	10.65%
3. Cost of funds	6.34%	7.19%	9.41%	10.08%	10.32%	10.40%
4. Net interest margin (NIM)	2.80%	2.09%	0.30%	–0.09%	–0.11%	0.02%
5. Return on assets (ROA)	0.74%	0.05%	–1.67%	–2.09%	–2.15%	–2.07%
6. Projected capital ratio at book value	6.18%	5.53%	3.94%	1.94%	–0.17%	–2.25%

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, the projected NIM (line C4) is 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 the projected 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 NI and thus regulatory capital adds 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 incorrect perceptions, the PCA regulations say nothing 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 the following: (1) the magnitude or depth of the decline in both the NII and NIM, (2) the lack of a meaningful recovery over the five-year horizon, and (3) 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 the benefit of hindsight, the depth of this problem is now obvious. 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.*

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.[18]

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:[19]

- No-rate-change scenario
  - Test 1: 10% deposit outflow over three months
  - Test 2: 20% deposit outflow over six months
- +500 bp shock test scenario
  - Test 3: 10% deposit outflow over three months
  - Test 4: 20% deposit outflow over six months

Before examining the results, remember 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.[20]

The results of these stress tests were expected and yet surprising by the depth of the problem. The results also confirmed 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 large 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.

Liquidity stress can be a problem even when interest rates are stable.

In the first month of outflows that spanned three months and amounted 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 0.96 times; by the third month, the liquidity coverage was only 0.62 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 0.49 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 three months and the 20% outflows over six months were augmented by the adverse effects of rates increasing 500 bps. As expected, the liquidity situation is far more dire as prepayments on mortgage loans and MBSs 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 0.75 times; by the third month it was 0.43 times. By the sixth month of the 20% test, the coverage was only 0.36 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.

Perspectives on S&L and Credit Union IRR

The plight of the S&L industry in the 1980s raises several questions. First, how did credit unions perform relative to S&Ls during this difficult period of record high interest rates? As with all depository institutions at that time, credit union performance deteriorated rapidly, but it was not as bad as that of the S&Ls, nor was it as prolonged. Their income performance recovered much faster.[21] In the late 1970s, credit unions were vanilla institutions. That is, they were primarily making small-denomination personal loans and auto loans funded almost entirely with savings deposits that were equivalent to the passbook accounts of S&Ls. Checking accounts, CDs, and MMAs did not come along until several years later, after the run-up in interest rates was well under way. As interest rates increased to record levels in the early 1980s, credit unions suffered depressed NIMs as the rapidly increasing cost of funds overwhelmed the interest income from their consumer loans. Liquidity pressure was widespread as Regulation Q initially limited the extent to which deposit rates could be raised in order to retain the deposits. Like S&Ls, credit unions were victims of disintermediation.

As Regulation Q was being phased out in the early 1980s, the cost of funds increased rapidly, as was the case with S&Ls. However, the interest income from loans and investments also began to increase, unlike the interest income from the long-term, fixed-rate mortgage loans and investments held by S&Ls. This was due to the very short average lives of the personal loans and auto loans with original terms that were typically only three or four years at that time. After several years of serious income problems due to margin pressure, credit union performance began to stabilize in the mid-1980s as interest rates receded from their record levels and NIMs began to recover as a result of the rapid runoff and repricing of the consumer loan portfolios and short-term investments.

With respect to the IRR of S&Ls versus the IRR of credit unions, perhaps the more interesting question is—how does the S&L balance sheet compare with the *current* credit union system's balance sheet in terms of IRR and risk-mitigating attributes? To address this question, consider Figure 10, a side-by-side comparison of the S&L balance sheet as of December 31, 1977, and the credit union system's balance sheet as of June 30, 2013.

One of the most glaring differences is the proportion of assets in fixed-rate first mortgage loans and MBSs: 77.2% for S&Ls versus only 25% for credit unions. But this does not tell the whole story. As pointed out earlier, virtually all of the S&L loans and MBSs had 30-year original terms because other variations were not offered on a widespread basis until the mid-1980s. In contrast, the aggregate credit union fixed-rate mortgage loan portfolio is diversified with five- and seven-year balloon loans along with

FIGURE 10

CONDENSED STATEMENT OF CONDITION: S&L INDUSTRY, DECEMBER 31, 1977, AND CREDIT UNIONS, JUNE 30, 2013

	S&Ls		Credit unions	
	$(M)	% of total	$(M)	% of total
Assets				
Cash and demand deposits	4,593	1.0	10,560	1.0
Investments (excludes fixed-rate MBSs)	34,604	7.6	316,074	29.9
Consumer loans	10,287	2.2	263,116	24.9
Fixed-rate mortgage loans and MBSs	354,391	77.2	263,622[1]	25.0
Variable-rate mortgage loans	0	0.0	74,378	7.0
Variable-rate HELOCs	0	0.0	39,467	3.7
Commercial loans	39,526	8.6	43,565	4.1
Other assets (net)	15,881	3.4	45,256	4.3
Total	459,282	100.0	1,056,038	100.0
Liabilities and net worth				
Checking accounts	0	0.0	119,034	11.2
Passbook/share accounts	146,742	32.0	345,179[2]	32.7
Money market accounts	0	0.0	208,837	19.8
Certificates	240,133	52.3	233,859[2]	22.1
Borrowed funds	27,803	6.0	26,442	2.5
Other liabilities	19,423	4.3	14,802	1.4
Net worth	25,181	5.5	107,885	10.2
Total	459,282	100.0	1,056,038	100.0

Sources: US League of Savings Associations, *Savings & Loan Fact Book*, 1978, p. 80; NCUA Financial Performance Report (FPR) Database, June 30, 2013.
1. Includes two-thirds of agency MBSs estimated to be fixed rate ($70,500).
2. Assumes one-half of IRA deposits in CDs.

those having original amortization terms of 10, 15, 20, and 30 years. The MBS portfolio is similarly diversified.

Although the composition of consumer loans in S&Ls is unknown, it was only 2.2% of assets. In credit unions these loans, most of which are auto loans, represent 24.9% of assets. In financial institutions such portfolios are fully seasoned. That is, they have remaining terms that range from a few months on old loans (due to aging) to six or seven years on new loans. When normal prepayments of 15% are taken into account, the average life of these portfolios is only about 16 months for used auto loans and 18 months for new auto loans, assuming typical underwriting criteria for loan terms.[22] Such portfolios not only reduce IRR but also produce strong and stable cash flows that would contribute to liquidity management in stressful situations.

HELOCs were nonexistent in S&Ls in the late 1970s, but by mid-2013 they were 3.7% of assets for credit unions. This loan type evolved in the late 1980s. Although not a dominant product in credit unions, the HELOC is one of the most powerful risk-mitigating assets due to its rapid repricing when short-term rates change.

The investment portfolio of credit unions (at 29.9%) is not only four times larger than that of S&Ls (at 7.6%) but also much shorter, with about one-quarter of the portfolio in overnight balances that reprice rapidly. In contrast, the much smaller S&L liquidity portfolio was made up primarily of Treasury bonds with a small component, 1% of assets, in federal funds.

On the liability side there are equally important differences. Low-cost checking accounts are widely recognized as de facto longer-term, nonvolatile, non-rate-sensitive deposits. As such, they are important risk-mitigating products. They are missing from the S&L balance sheet but represent 11.2% of total Liabilities & Net Worth for credit unions. This helps offset the smaller CD program for credit unions at 22.1% versus 52.3% for S&Ls. The MMA at 19.8% for credit unions is a critically important product because it allows for more effective identification and segregation of rate-sensitive and non-rate-sensitive deposits in ALM modeling, thus reducing model risk. Finally, another important difference is the capital ratio—only 5.5% for S&Ls versus 10.2% for credit unions. Thus, the ability to absorb risk and recover from adversity is far greater for credit unions now than it was for S&Ls in the 1980s.

This review raises a final question—given its present balance sheet structure, could the credit union system be subjected to an S&L-style crisis in the event of a major run-up in interest rates? When answering this question, it is important to bear in mind that S&Ls were homogeneous with respect to IRR due to their legally mandated, high-risk balance sheet structure. As a result, they were like dominoes—when one went down, they all fell. On the other hand, there are important differences between S&Ls of that era and modern credit unions in terms of their balance sheet structures and IRR profiles, to say nothing of

a far more stringent regulatory environment. Furthermore, there is a wide range of balance sheet structures and IRR profiles *within* credit unions, so the impact of a significant increase in interest rates is likely to vary considerably from one institution to another.

On the surface, this seems to suggest that a reoccurrence of such a widespread systemic crisis is unlikely for credit unions. However, if interest rates were to return to the double-digit levels that characterized the early 1980s, all bets would be off. The damage is unlikely to match that of the S&L crisis, but to borrow a phrase from a well-known movie—"There will be blood."

With interest rates still near their manipulated, record lows at year-end 2013, a return to more "normal" levels of only 4%–5% for the federal funds rate and 6%–7% for mortgage loans could precipitate problems.

It could plausibly be argued that the likelihood of interest rates reaching the double-digit levels of the 1980s is remote.[23] This could prove to be true, but such a scenario may not be necessary for rising interest rates to cause problems in *individual* institutions depending on their ALM position. With interest rates still near their manipulated, record lows at year-end 2013, a return to more "normal" levels of only 4%–5% for the federal funds rate and 6%–7% for mortgage loans could precipitate problems. The key in these situations will be the depth of the problem and the speed of the income recovery, as demonstrated in the next chapter.

CHAPTER 3

The Income Simulation Horizon

The purpose of this chapter is to examine the analytical horizon in the income simulation component of an ALM analysis. The issue arises because there is a preference on the part of some practitioners and ALM consultants to focus on short-term results, i.e., only the first year or two of projected income performance, whereas regulators recently have shown a distinct preference for longer-term horizons such as five years. The issue is important for two reasons. First, the failure to examine a proper income simulation horizon may result in an incorrect assessment of IRR. In fact, as will be demonstrated, the greater the IRR, the longer the horizon that must be analyzed in order to get an accurate assessment of the

depth and severity of the problem. Second, in light of the extended period of historically low, manipulated interest rates, the aftermath of the Great Recession, and the temptation (or need) to extend asset maturities to enhance yield, an accurate IRR assessment is now more critical than at any time in the past.

The next section provides some background on the analytical procedures currently being used. This discussion is necessary to place the income simulation horizon issue in its proper perspective. This will be followed by the pros and cons of the different viewpoints and clarification of the need for a longer horizon than currently being used by most practitioners.

Background

Limitations of Economic Value Analyses

As explained in Chapter 1, the most widely used and accepted analytical tool for an IRR assessment is an economic value analysis. This is known as net economic value (NEV). As the name implies, this is a valuation procedure. The market value of net worth is estimated by finding the difference between the present value of the existing asset-related cash flows and the present value of the existing liability-related cash flows, both of which are discounted at either current or shocked market rates. The resulting value may then be expressed as an NEV ratio by dividing by the current or shocked market value of the assets. In other words, rather than calculating a capital ratio using book values, this procedure uses market values. The change in the current NEV when shocked by a change in interest rates provides an indication of the extent to which the institution has IRR. Its primary advantage is that it captures the long-term nature of the cash flows and options embedded in most balance sheets, such as those arising from fixed-rate mortgage loans, prepayments, and callable bonds. For this reason, the long-term modeling horizon is defined by the valuation methodology itself.

Care must be exercised when using an economic value approach due to its limitations. The results must be related to the underlying capital base in order to assess the institution's ability to handle the risk indicated by the NEV analysis. Furthermore, if the capital ratio at book value is low initially, the shocked NEV may also be low in a rising rate shock test, thus indicating IRR that may not be present.

A troublesome aspect of an NEV analysis is that it is often heavily dependent on assumptions for valuing NMDs that can vary greatly from one institution to another. For these reasons, NEV results should be confirmed by the income simulation results.

Even when properly used, another problem with an economic value analysis is that as a single summary statistic, it lacks context in that it does not explicitly focus on core earning power and its ultimate impact on statutory capital. Unless the NEV is a polar case involving an extreme IRR position, it is often difficult to tell just where an NEV number alone lies on the IRR spectrum for a particular institution and its capital position. Furthermore, there is no *explicit* reference to the effects of changing interest rates on earning power. This is where income simulation comes into play by providing the necessary context.

One problem with an economic value analysis is that as a single summary statistic, even when properly used, it lacks context. It does not explicitly focus on core earning power and its ultimate impact on statutory capital.

Income Simulation Procedure

Since the primary purpose of an IRR assessment is to estimate the impact of changing interest rates on future income performance, asset values, liquidity, and capital, it is logical to expand the ALM analysis to *explicitly* examine these effects, which are mathematical by-products of an NEV analysis. The income-related focus of the NEV analysis is the relationship between the projected interest income and interest expense and how both may respond to a changing rate environment. The difference between the two is, of course, the NII. In other words, the income effects over time as characterized by the NII are summarized by the NEV, its mathematical counterpart.

In addition to the NEV measures, the other critical measures of IRR in a shock test are (1) the percentage change in the NII from the simulated no-rate-change base case, (2) the magnitude of the changes in the NII over an extended time frame, and (3) the NII recovery timeline (or the lack thereof). Central to this analysis is the horizon over which the NII is examined. As explained later, an extended, multiyear framework is a necessity in most cases for this purpose.

This procedure may be extended in order to estimate the effect of the rate shock on NI and statutory capital. To do this, estimates must be made for operating expenses, fee income, and loan loss provision expense over the analytical horizon.

On the surface, this procedure appears to be a forecast of the NII and NI in an accounting or budgeting sense. This is *not* the case, however, because budgeting and an IRR assessment are entirely different problems. Rather, the income simulation component is an estimate of the *magnitude and directional sensitivity* of the effects of changing interest rates on the NII, NI, and, ultimately, statutory capital. In this way, it provides an estimate of *earning power at risk* resulting from a unique yield curve shift and its potential effect on the future

income-generating capacity of a particular balance sheet. There is a big difference between projected earnings in a budgeting sense and earning power sensitivity under unique, hypothetical conditions for the purpose of determining the extent of IRR and safety and soundness.

In the case of budgeting, interest income and expense must be estimated to produce the NII, as in a risk assessment, but this is usually conducted assuming no change in interest rates.[24] Income simulations, on the other hand, are stress tests that can cover a wide range of interest rate scenarios, and the no-change scenario is usually not the primary focus as it is in the budgeting process. Also, the balance sheet is allowed to change in a budget, but in an IRR assessment, the balance sheet should be held constant since the related NEV is a valuation problem that must be conducted at a point in time for the *existing* balance sheet.[25] In addition to all of this, a budget requires an estimate of loan loss provision expense and detailed estimates of all operating expenses and fee income. Not surprisingly, budgeted figures often vary significantly from actual figures even though the usual timeline is for only one year. For this reason, it is argued that any form of income-related forecasting for longer periods will have rapidly diminishing accuracy and should not be relied on. This is certainly true in the case of budgeting. But an IRR assessment is not budgeting.

The Simulation Horizon

As pointed out above, some analysts argue that an analysis of the related income simulation results should not extend beyond the first year or two. Regulators, on the other hand, recommend a longer horizon of five to seven years in the case of more complex institutions.[26] As explained in this section, the regulatory recommendation has considerable merit in improving the accuracy of an IRR assessment.

The Short-Term Horizon

A common argument is that a longer-term income simulation horizon such as three to five years makes no sense, because this requires too many assumptions about the future and it is not possible to forecast income components that far out. This statement would be true if the procedure were actually used to project income in a budgeting sense over a long period. But this is neither the intent of income simulation nor does anyone use it for this purpose. *Income simulation measures the magnitude and directional sensitivity of earning power at risk under various hypothetical scenarios.* It is a barometer of core earning power under simulated stressful conditions. To the extent that this sensitivity is deemed excessive, the risk profile should be adjusted so the projected outcome does not materialize.

It is also contradictory to argue that the long-term horizon is inappropriate for income simulation when essentially the same valuation inputs and assumptions are used along with

an even longer horizon to determine the cash flows for its mathematical counterpart, the NEV analysis. Stated another way, for every NEV analysis there is a corresponding stream of cash flows that produce the NII. This raises the question—why would these assumptions be appropriate for one approach but not the other when the results are just different ways of expressing most of the same inputs and assumptions? The NEV and NII results are mathematically related and are two sides of the same coin. Since the assumptions are the same, the NEV and income simulation results should be equally reliable.[27]

Another argument is that since the balance sheet is growing and its composition changing over time, the intermediate- or long-term income projections would be meaningless, so the focus should be on very short-term results. Again, this assertion is correct, but it misses the key point of an income simulation analysis. As pointed out above, in addition to not being used to predict income in a budgeting sense, the balance sheet should be held constant when measuring IRR since the valuation process takes place at a point in time, not over time. Furthermore, most of the IRR facing an institution in the short- and intermediate-term is in the *existing* balance sheet, not in its modest incremental growth. To the extent that the balance sheet evolves and changes over time (as all balance sheets do), the related income and IRR effects can be detected and evaluated by frequent ALM analyses (such as monthly or quarterly).[28] An IRR assessment is not an annual event.

There are other problems with a short-term income simulation horizon. The simulation results in year 1 can be heavily influenced by the manner in which the rate shock is applied, which in turn can magnify or delay its full impact. For example, if an immediate +300 bp rate shock is applied and institutions respond only partially to such a movement, the year 1 income results will be greatly distorted. Consider depository institutions that are liability sensitive; that is, they have a large volume of liabilities in MMAs and maturing CDs subject to repricing within a very short period. To reprice all of these rate-sensitive liabilities upward even partially on an immediate rather than a more gradual or ramping basis is misleading at best because neither the Fed nor the markets work this way.[29] Similarly, for asset-sensitive institutions, immediately repricing upward a large volume of loans indexed to the prime rate or the London Interbank Offer Rate (LIBOR) is equally misleading since this would increase interest income far more rapidly than would ever actually occur.

Repricing rate-sensitive liabilities upward even partially on an immediate rather than a more gradual or ramping basis is misleading at best because neither the Fed nor the markets work this way.

If a more realistic ramping procedure is used, such as a 12-month period, the full income effect of the rate shock may not be felt until *after* the first year. Also, to the extent that the institution delays its response to changing rates or otherwise lags the market on the deposit

side (a common practice), the full effect of changing interest rates will be correspondingly delayed.

The ultra-low interest rate policies of the Fed in the aftermath of the Great Recession have led regulators to increasingly require a range of stress tests to analyze the effects of a much higher rate shock, such as +400 or +500 bps. Although experience from the early 1980s shows that such moves occurred within short periods, it is reasonable and plausible to assume that such increases would occur over periods such as 12, 18, or even 24 months. This could delay the full NII effect of the rate shock until the second or third year of an income simulation horizon. In such cases it is important to look at the income simulation results beyond year 3 to examine the speed of recovery (or the lack thereof). Such severe rate increases may be accompanied by the early withdrawal of CDs but only *after* interest rates increase sufficiently to a point where paying a penalty is economically feasible to savers. Again, this passage of time may delay the full impact of the rate shock, thus distorting the projected income results of the first year or two.

Unless assets and liabilities are perfectly balanced in terms of repricing, the NII performance in the first year or two can hardly be an accurate representation of the full impact of major rate shocks on the earning power of balance sheets.

During the time that rising rates may be adversely affecting the cost of funds, the asset returns may be simultaneously adjusting upward and recovering during this extended time frame. This means that unless the assets and liabilities are perfectly balanced in terms of repricing, the NII performance in the first year or two can hardly be an accurate representation of the full impact of major rate shocks on the earning power of balance sheets. Only with the passage of time in an extended, multiyear analysis is it possible to see the full interplay of *both* sides of the balance sheet as it goes through the repricing and adjustment process. In summary, the income simulation horizon must be long enough to allow all of the forces to play out under stressful but realistic assumptions.

The Case for a Longer Horizon

Much of the case for a longer income simulation horizon is, in effect, made by pointing out the limitations of a short-term horizon, as discussed above. But there is much more to the horizon issue.

Since the shocked earning power in the first year or two may be distorted, as explained above, extending the horizon to at least three but preferably five years is typically necessary to provide a sufficient IRR assessment. In addition to avoiding the early-year distortions that may arise, the true depth of the risk profile must be determined by

understanding the severity of the problem, the timing and speed of the projected income recovery (or the lack thereof), and the potential impact on regulatory capital. This was demonstrated in Chapter 2, which examined in detail the poster child of IRR mismanagement, the S&L industry in the late 1970s and early 1980s.

In that chapter several rate scenarios were analyzed and applied to the S&L industry's 1977 balance sheet to determine whether modern analytical tools would have been able to detect the depth of the problems that were about to emerge. This balance sheet is shown again in Figure 11, a cursory review of which reveals a high degree of IRR. Residential

FIGURE 11

CONDENSED STATEMENT OF CONDITION, S&L INDUSTRY, DECEMBER 31, 1977

Assets	$(M)	% of total	Liabilities and net worth	$(M)	% of total
Cash and demand deposits	4,593	1.0	Savings deposits		
Liquid investments			Passbook accounts (5.00%)	146,742	32.0
Federal funds (6.50%)	4,593	1.0	Certificates (7.00%)	240,133	52.3
US Treasuries (7.00%)	25,149	5.5		386,875	84.3
Other investments (7.25%)	4,862	1.1	Borrowed funds		
	34,604	7.6	FHLB advances (7.50%)	19,952	4.3
Mortgage-related assets			Other borrowings (8.00%)	7,851	1.7
Residential loans[1] (8.96%)	341,690	74.4		27,803	6.0
Commercial loans (9.25%)	39,526	8.6	Other liabilities		
MBSs[2] (8.25%)	12,701	2.8	Loans in process	9,932	2.2
	393,917	85.8	Other liabilities	9,491	2.1
Consumer loans (8.00%)	10,287	2.2		19,423	4.3
Other assets			Net worth	25,181	5.5
FHLB stock	3,200	0.7			
Building, equipment, other	12,681	2.7			
	15,881	3.4			
Total assets	$459,282	100%	Total liabilities and net worth	$459,282	100%

Source: US League of Savings Associations, *Savings & Loan Fact Book*, 1978, p. 80.
Note: The rates shown in parentheses were the current market rates at that time and were either obtained from the St. Louis Federal Reserve Bank or estimated by the author.
1. 1 to 4 family units and apartments
2. Primarily passthrough securities

mortgage loans and MBSs made up over 77% of assets, virtually all of which were fixed-rate with original amortizing terms of 30 years since this was the only mortgage product widely offered at that time. Risk-mitigating products such as variable-rate mortgage loans, HELOCs, and non-rate-sensitive checking accounts did not evolve until later in the 1980s. Note that in order to support this risk, the industry's capital ratio was only 5.5%.

In this chapter, two of the ALM analyses that were presented earlier will be reexamined with emphasis on the need for an extended income simulation horizon. The first of these was a +300 bp shock test in which the increase was ramped over a 12-month period. This was a reasonable and yet stressful test given the rate environment and volatility that characterized the bond market up to that point in time. The increase in the passbook accounts was lagged one month and assumed to increase by 80% of the rate shock.[30] In addition to the income simulation results (the focus of this chapter), the economic value (NEV) effects were also examined in detail in order to clearly establish the linkage between the NEV and the NII results. The second test was a +500 bp shock test ramped over 18 months for the purpose of income simulation.

As pointed out earlier, the NEV alone lacks the necessary context to place IRR in its proper perspective and determine where it lies on the risk spectrum. Although the NEV is a valuable theoretical concept, it focuses on projected earning power *implicitly* rather than *explicitly*, as in the case of income simulation. The results of both analyses are shown in Figures 12 and 13.

Note on line A1 in Figure 12 that the change in NII from the no-shock base case is –21% in year 1, which is also the ramping period. Also note the significant decline of 54% in year 2, which is a more complete reflection of the full impact of rising rates relative to year 1. But the decline accelerates further in year 3 and remains at an elevated level until it stabilizes somewhat around year 4 with minimal improvement in year 5. Using estimates of fee income and operating expenses as a percentage of assets, and estimates of loan loss provision expenses as a percentage of loans, the resulting earning power was estimated. As indicated on line A2, in this +300 bp, 12-month ramp test for income simulation, the industry would have been deep in the red in year 2 with NI declining almost 200% from the base case *with no meaningful recovery in sight*.

The impact of the sustained operating losses over time is shown on lines B1–B6. The projected capital ratio deteriorates from the base case projection of 6.18% to 2.52% by the end of year 5. This projection shows that the industry would be in a dire situation in the event of a relatively modest +300 bp increase in rates ramped over 12 months. It would run out of recovery time and capital. Developing this insight is a key reason why an extended horizon is necessary.

FIGURE 12

SIMULATED PERFORMANCE OF S&L INDUSTRY, 12/31/77 NCUA TEST:
IMMEDIATE +300 BPS FOR NEV, RAMPED 12 MONTHS FOR INCOME SIMULATION ($M)

		Shocked +300 bps (12-month ramp)				
	No shock	Year 1	Year 2	Year 3	Year 4	Year 5
A. Projected % change in:						
1. Net interest income (NII)	—	–21%	–54%	–59%	–61%	–58%
2. Net income (NI)	—	–75%	–193%	–213%	–217%	–208%
B. Simulated key ratios:						
1. Interest income/average assets	8.33%	8.45%	8.70%	8.92%	9.13%	9.33%
2. Yield on average earn assets	8.79%	8.84%	9.11%	9.33%	9.55%	9.76%
3. Cost of funds	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)	0.74%	0.18%	–0.70%	–0.85%	–0.90%	–0.83%
6. Projected capital ratio at book value	6.18%	5.66%	5.00%	4.19%	3.33%	2.52%
C. 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. Basis point change from current NEV	–1,066					
5c. % change from current NEV	–182%					
5d. Shocked NEV ratio	–5.17%					

This analysis leads to an important conclusion—the greater the IRR, the greater the need for a longer horizon to properly assess the depth and magnitude of the risk problem. To see this, consider a theoretical benchmark in which an institution has zero IRR. This being the case, the percentage change in its NII will (in theory) be zero over the entire five-year horizon. This means that years 1 and 2 of the income simulation will convey an accurate risk assessment, i.e., zero risk in this polar case. However, when IRR is present, the earlier years may not portray an accurate assessment of the income effects, as discussed above, and the

FIGURE 13

SIMULATED PERFORMANCE OF S&L INDUSTRY, 12/31/77 REPLICATE ACTUAL EVENTS: IMMEDIATE +500 BPS FOR NEV, RAMPED 18 MONTHS FOR INCOME SIMULATION ($M)

		Shocked +500 bps (18-month ramp)				
	No shock	Year 1	Year 2	Year 3	Year 4	Year 5
A. Projected % change in:						
1. Net interest income (NII)	—	–26%	–89%	–103%	–104%	–99%
2. Net income (NI)	—	–94%	–320%	–370%	–372%	–356%
B. Simulated key ratios:						
1. Interest income/average assets	8.33%	8.46%	8.92%	9.35%	9.77%	10.18%
2. Yield on average earn assets	8.79%	8.86%	9.33%	9.79%	10.23%	10.65%
3. Cost of funds	6.34%	7.19%	9.41%	10.08%	10.32%	10.40%
4. Net interest margin (NIM)	2.80%	2.09%	0.30%	–0.09%	–0.11%	0.02%
5. Return on assets (ROA)	0.74%	0.05%	–1.67%	–2.09%	–2.15%	–2.07%
6. Projected capital ratio at book value	6.18%	5.53%	3.94%	1.94%	–0.17%	–2.25%
C. 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. Basis point change from current NEV	–1,913					
5c. % change from current NEV	–299%					
5d. Shocked NEV ratio	–13.65%					

greater the risk, the greater the potential distortion in the early years, as highlighted on line A1 in Figure 13. Hence the need for a longer horizon when risk is present, as it often is.

The greater the IRR, the greater the need for a longer horizon to properly assess the depth and magnitude of the risk problem.

A modern depository financial institution is unlikely to have a risk profile that even remotely resembles that of the S&L industry and the risk profile shown in Figure 12.

In practice, institutions with a low degree of IRR that use a +300 bp rate shock with a 12-month ramping procedure may show a modest deterioration in the NII in years 1 and 2 from the base case and then a recovery in the NII in subsequent years. However, institutions with a high degree of risk could show a pattern somewhat similar to that of the S&Ls, although obviously not so severe. That is, *relative to low-risk institutions, high-risk institutions show steeper declines in the NII and a longer time frame for stabilization and recovery*. Analyzing this time frame is a crucial component of an IRR assessment.

Relative to low-risk institutions, high-risk institutions show steeper declines in the NII and a longer time frame for stabilization and recovery.

In order to more closely examine the recovery time frame and capital issue, the second test was conducted in an attempt to replicate what actually happened in the late 1970s and early 1980s. For this purpose, a +500 bp shock test was applied on a ramped basis over 18 months. The early withdrawal of some CDs was assumed to be due to the magnitude of the rate shock and the fact that this was a major problem at that time. The results are shown in Figure 13.

Once again, note on line A1 the sharp deterioration in the NII during years 1 and 2, the ramping period. NI is almost wiped out in year 1, and it deteriorates rapidly thereafter. It is clear from the worsening performance in subsequent years that the severity and time frame of the potential income problems are such that a meaningful recovery is out of the question. This is confirmed in the simulated key ratios, shown on lines B1–B6, especially the simulated impact on the NIM, which is actually negative in year 3. Note that regulatory capital is projected to be completely wiped out in year 4. This is further evidence that the depth and time frame of the IRR problem would not be revealed by focusing only on the first year or two, so a longer-term horizon is essential to provide a more in-depth assessment, especially when a high degree of risk is present.

In addition to the various reasons cited above, and in the context of the S&L analyses, the need for an extended income simulation horizon may come into play in unusual or unexpected ways. For example, during the prolonged period of ultra-low interest rates from late 2008 through 2013 and projected by the Fed to persist, the normal focus of shock testing is to ask—what happens if interest rates go up? This is the logical and necessary focus. However, a related and equally important question arises—what if the Fed keeps rates at a depressed level for an extended period as it was projecting? This is equivalent to a no-change rate shock, so an NEV analysis would provide no managerial insight or any indication of potential problems. However, a no-change income simulation scenario may reveal that the adverse income effects of redeploying loan runoff into lower-yielding loans has the potential to lower the yield on earning assets without a commensurate effect on the cost

of funds as the latter reaches its lower limit. The full extent of this risk to the NIM is much more evident over an extended income simulation horizon. Depending on the severity and timeline of this problem, corrective action may be required. But the problem and its scope must first be identified by means of an ALM analysis.

CHAPTER 4

Implementing ALM and 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 chapter. The role of judgment is cited to stress that the ALM process is not a mechanical, "black box" exercise that always produces clear and unambiguous results on a pass/fail basis. This point will be stressed below.

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 (OCC), the OTS used a +200 bp parallel, instantaneous, and permanent rate shock. The NCUA's test is similar but +300 bps. From a regulatory standpoint, these are plausible tests, but at the institutional level, other tests should be conducted. The FFIEC recognized this in 2010 when it 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.*[31]

Note the emphasis on the phrase "severe but plausible." This will come up later.

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. These are 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 federal funds rate and the prime rate. However, fixed-rate first mortgage loan rates are driven primarily by the 10-year Treasury rate. This is important because short rates are far more volatile than long rates.[32] This unpredictable relationship between short and long rates is contrary to the parallel rate shift assumption underlying the standard NEV tests and is the very reason standardized stress tests are necessary.

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 indicated by the FFIEC.

Consider what happened from mid-2004 to mid-2006, a period of 24 months. Short rates increased 425 bps, but the 10-year Treasury rate and the rate on 30-year fixed-rate mortgage loans were relatively stable, fluctuating only about 50 bps 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 accounted for 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 even +500 bps. 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 indicated by the FFIEC.

No-Rate-Change Scenario

Although the primary focus of scenario testing is usually on rising rates, another test that may be conducted is a multiyear, no-rate-change test using income simulation. In an extended, low-rate environment such as that characterized by the 2008–13 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 multiyear context as 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 revealed only in an extended multiyear 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 for several years. The Fed followed this up with an announcement in September 2011 that it would attempt to drive down long-term rates in "Operation Twist." These policies had important implications for depository institutions already dealing with margin pressure from historically low interest rates and asset returns declining faster than the cost of funds as the latter began to reach its lower limit.

Ramped versus 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 300 bps in one day, it makes no sense to model such behavior. Remember, the modeling must be severe but plausible. Accordingly, during a period of changing rates it makes sense to ramp the changes over some reasonable time frame, such as 12 months for 200 or 300 bp tests and 18 or 24 months for 400 or 500 bp tests. This is where judgment comes into play, along with some common sense. An added advantage of using the ramped procedure is that the income simulation results are far more credible to risk managers and directors and thus are not summarily rejected, as is often the case with unrealistic, immediate shock tests.

Interactive Effects of IRR and Credit Risk

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 bps in rates may

have a minimal impact on the credit quality of loan portfolios. However, an increase of 400 or 500 bps could increase the risk of delinquency and default and thus loan losses on 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.

In the near future, perhaps beginning around 2015, the interactive effects of IRR and credit risk may manifest themselves in yet another way and pose a problem for some lenders. Many borrowers utilized the HELOC during the housing bubble that peaked in mid-2006. Housing prices then collapsed by about one-third nationwide, thus precipitating the Great Recession that followed. Generally, because of the ever-increasing housing values up to that point, these loans were written with lax underwriting standards relative to current requirements, often including high LTV ratios. Since many of these loans were written with a 10-year draw period, they will soon begin to expire. In addition to the normal exposure to rising rates, these variable-rate loans must then be restructured into fully amortizing loans with payments covering both principal and interest. This is in sharp contrast to many HELOCs that were required to pay only interest during the draw period. In recent years the HELOC rate, which is usually tied to a short-term index, has been kept artificially low due to the monetary policy of the Fed in its attempt to stimulate the economy. Clearly, the level of future interest rates and the magnitude of the housing recovery—or the lack thereof—will determine the extent of the potentially adverse, interactive effects resulting from a combination of payment shock and a corresponding deterioration in credit quality.

Ordinarily, IRR and credit risk are independent. However, in a severe interest rate stress test such as +400 or +500 bps, and to the extent that this interactive form of credit risk may be present (another judgment issue), an increasing loan loss provision expense could be simulated over the five-year income simulation horizon in a what-if to examine the combined impact of increasing loan losses and IRR on earning power and regulatory capital.[33]

Non-Maturity Deposits

Since NEV is a valuation approach, a vexing implementation problem arises when valuing checking accounts, savings accounts, and MMAs, collectively known as non-maturity deposits (NMDs). As the term implies, these accounts do not have a specified maturity. The funds in these accounts are immediately withdrawable at the discretion of the depositor, and thus 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 like 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. Thus, 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:

- The assumed average life (or its counterpart, the so-called decay rate).
- The speed of responsiveness (or the lack thereof) to changing interest rates.
- The cost of the deposits plus their servicing cost relative to their replacement cost.[34]

As summarized below, these attributes must be thoroughly understood in the NMD modeling process since they determine the degree of risk mitigation.

Average Life (or Decay Rate)

NMD history can be analyzed to determine the extent to which the deposits "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 life as the accounts decline over time through normal attrition. For example, a decay rate of 20% corresponds to an average life of 5 years; a 10% decay rate corresponds to a 10-year average life. A necessary, but by itself insufficient, condition for risk mitigation is a long average life.

Responsiveness to Changing Rates

If a liability responds quickly and in a manner commensurate with changing interest rates, such as an MMA, it will offer very little risk mitigation regardless of its average life. This is 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 life. However, if it is slow to reprice and lags the market like most savings accounts, these features may provide IRR mitigation when combined with a long average life assumption.

Cost versus Replacement Cost

A final ingredient in valuing NMDs is their cost to the institution plus the related servicing cost relative to the cost of replacing those deposits. For example, in a more normal rate environment—unlike that of the 2008–13 period, when the Fed was holding short-term rates

close to zero—if a savings account has an all-in cost of, say, 2% when the market rate or replacement cost for comparable average life 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 life 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 life and responsiveness to changing rates. The replacement cost for comparable average life 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 life, as discussed above, is further augmented by the correspondingly higher discount rate associated with the longer average life. However, if the deposit is a variable-rate product subject to rapid repricing, such as an MMA, a short-term borrowing rate such as the overnight rate is appropriate regardless of the assumed average life.

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 or very little interest, 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 life, the replacement cost of traditional checking accounts historically has been higher than the rate paid on such accounts plus their servicing or noninterest 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 market rates increase, and in general they tend to have a low degree of sensitivity to changing interest rates if an MMA and CD program are in place. Typically, their replacement cost is higher than the offering rate plus the servicing cost on the 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.

- MMAs. If these accounts consistently pay a competitive market rate and respond quickly to changing rates, they will function in a manner similar to a variable-rate product. Therefore, these accounts will not decline materially in value in a rising rate environment, so IRR mitigation is minimal at best and a long average life assumption will contribute little to risk mitigation. However, MMAs may provide some NEV benefit if a below-market rate is paid, if rate increases are delayed, and if they respond only partially to rising rate conditions.

NMD accounts typically make up 40%–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.

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 like long-term deposits even though individually they are immediately withdrawable. Using an actual, historical average life of 5–10 years (or even longer) for checking and savings accounts typically causes the shocked NEV ratio to improve dramatically and appears to mitigate risk. This is because their theoretical, long average maturities may cause the NMD account value to decline, much like a long-term bond 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 assumption and responsiveness to changing rates. However, there is no uniformity in estimating procedures, nor is there a regulatory safe harbor in making NMD

assumptions. Therefore, NEV results can vary considerably from one institution to another even if they have identical balance sheets and IRR.

Core deposit studies are often used to address this issue by analyzing the longevity (or average maturity) of NMDs. The results often show that these deposits have long average maturities ranging from 5 to 10 years. These values are then used to estimate their theoretical value under different rate environments for NEV purposes. Such studies require an explicit assumption that future deposit behavior will be similar to past behavior. This seems to make sense because future behavior is often similar to past behavior—but not always. We know from the liquidity history of S&Ls that this behavior depends heavily on the interest rate environment. When rates are high or rising, there is a tendency for depositors to migrate to higher-yielding products like CDs, MMAs, bond funds, or money market mutual funds if rates offered by depository institutions lag the market in a meaningful way. Correspondingly, when rates are declining or unusually low for an extended period, the rate incentive to tie up funds in longer-term deposits tends to diminish. NMDs may grow with increases in rate-sensitive deposits, thus contaminating what would otherwise be non-rate-sensitive accounts. This complicates IRR assessments and increases the risk of model error.

Core deposit studies often show that NMDs have long average maturities ranging from 5 to 10 years. Such studies require an explicit assumption that future deposit behavior will be similar to past behavior.

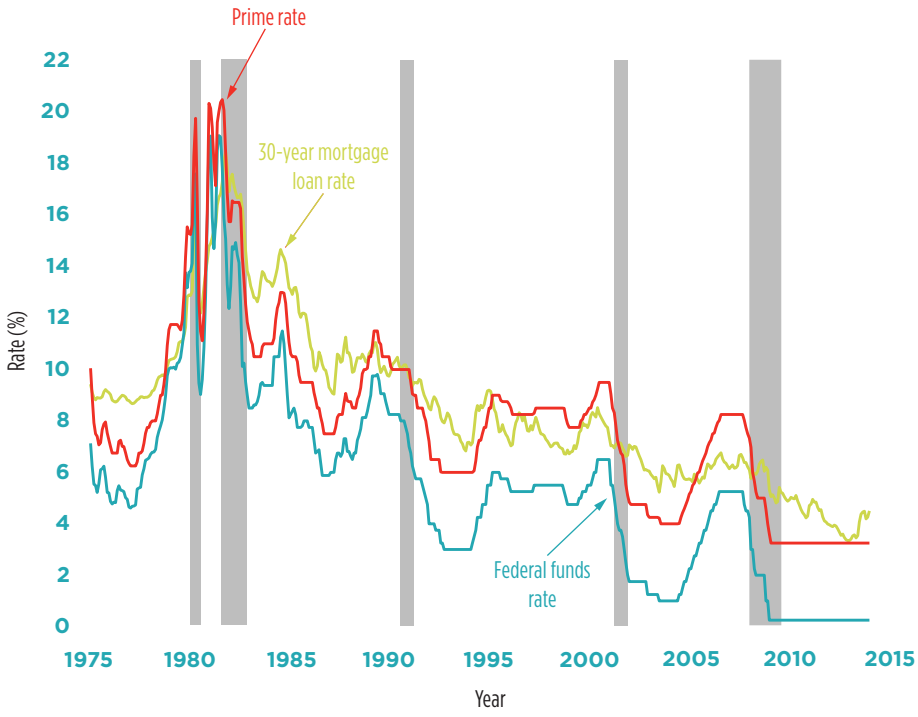
Consider the interest rate environment at year-end 2013 relative to the past. As shown in Figure 1 in Chapter 1 and repeated here as Figure 14, in the early 1980s the prime rate peaked at over 20% and 30-year mortgage loan rates exceeded 16%. At year-end 2013 these rates were 3.25% and 4.50%, respectively. In other words, for the past three decades we have witnessed an unprecedented secular decline in interest rates, a period during which virtually all NMD studies were conducted. Thus, the question arises—is it reasonable to assume that future behavior of interest rates and thus NMDs will continue to mimic past behavior even though the federal funds target and other short rates are virtually zero? Although this may be viewed as a standard modeling procedure, the assumption may result in understating IRR as measured by the NEV. Clearly, caution must be exercised along with sound judgment.

This problem arises because NMDs contain an *embedded but undefined option* for savers to withdraw the funds in a manner that may not be reflected in historical core deposit (or decay) analyses. This could be especially problematic if the future interest rate environment turns out to be unlike that of the past.[35]

The valuation problem this creates is somewhat analogous to a callable bond on the asset side. To see this, consider a new five-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 five-year bond; if rates decrease, it will tend to be valued more like a one-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, have historically behaved like 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.

FIGURE 14

INTEREST RATES, 1975–2013



Source: St. Louis Federal Reserve Bank.
Note: Shaded areas represent recessions. The federal funds effective rate is shown for the period January 1975 to August 1982, and the federal funds target rate is shown for the period September 1982 through 2013.

Under certain conditions, assuming long average maturities when valuing NMDs 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 is not reflected in the long average life 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 an otherwise 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 rather than NEV alone.*

Admittedly, 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, as the S&Ls discovered in the early 1980s.

From the history of S&Ls, the ALM simulations conducted in Chapter 2, 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. *Even when NMD average maturities are based on technically sound analytics, what may ultimately prove to be incorrect assumptions can unexpectedly 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 pointed out earlier, interest rates have been at historically low levels from late 2008 through 2013. They may even remain at these levels for several more years. This is a result of the Great Recession and Federal Reserve monetary policy.

Even when NMD average maturities are based on technically sound analytics, what may ultimately prove to be incorrect assumptions can unexpectedly mask IRR and liquidity risk.

In a subtle way, this Fed policy elevated 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 life in order to provide a margin of safety or allow for what could prove to be model error.

Policy Issues, Conflicts, and 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 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 0.20%, even a small increase in interest rates could wipe out the low 0.20% 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 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 a 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 showed a significant decline in the post-shock NEV in percentage and basis point terms due to the large holdings of mortgage loans and relatively low capital ratio. However, this institution has a large interest-bearing checking account paying a 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.[36] Thus, the income simulation results showed that the NII and NI would *increase* in a +300 bp environment. This is contrary to what would be expected given the NEV results. In contrast to the low shocked NEV, this indicated that the institution had 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.)

Caution: NEV and income simulation approaches usually show consistent results—but not always.

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 ongoing, the 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 shifts. 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 nonparallel yield curve shifts, the results should *not* be compared with policy guidelines that relate to a standardized regulatory 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 MMA is likely to have commingled non-rate-sensitive and rate-sensitive balances that, in effect, sensitize the entire account. This is because in a rising rate environment the rate must be raised on all funds in order to retain the rate-sensitive balances.[37] 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.

Qualitative Component of ALM

This report 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, ongoing ALM training, and the integration of IRR management with the strategic plan of the organization. This is the "people side" of the ALM process.

If an institution has what appears to be a low degree of IRR 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.

Sensitivity and 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 life 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* that we are dealing with theoretical values rather than actual values.[38] The resulting values are opinions, not facts. Things can change and put the institution at risk. This is why risk managers should always consider building a margin of safety into estimates to account for possible errors in the estimate. A sensitivity analysis is one way to address this issue.[39] 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 life assumptions.

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.

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. These exercises integrate the ALM process with the strategic plan of the organization.

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 ongoing 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.

CHAPTER 5

The ALM Validation Process

This chapter focuses on the concept of modeling risk in the ALM process and the potential errors in the assessment of IRR. To address this issue, regulators of depository financial institutions—credit unions, banks, and thrifts—are increasingly requiring greater oversight, internal controls, and some form of model validation in order to minimize model risk and incorrect risk assessments. Like any forward-looking modeling process, ALM involves certain inputs, assumptions, judgments, and estimates of complex interrelationships, some of which are not only unknown but unknowable. The result is, of course, forecasting error. This is a normal part of the forecasting process, and some of it is unavoidable. The question is—how can this risk be minimized through the validation process?

To address this question, it is important to understand regulatory requirements, the nature and causes of modeling variances, and the advantages and limitations of the various validation procedures. To the extent that the modeling results match up reasonably well with actual results, the model may then be deemed to be providing reliable risk assessments. The following sections address these issues.

Modeling Variances

As pointed out above, the forward-looking, complex modeling process that makes up an IRR assessment is a haven for forecast errors. These errors can result from a variety of sources. In addition to routine random "noise," among the more significant causes are a lack of modeling experience or training; bad data; unknown events materializing subsequent to an analysis; a change in expected behavior of the institution, the markets, and/or consumers; unreasonable or incorrect assumptions; or even deliberate manipulation to produce favorable results. It is clear from this list that some causes may be addressed by training and oversight in the modeling process. However, other external causes of forecast errors are simply the result of events that are unknowable at the time of an analysis and random "noise." This means that model variances are an unavoidable by-product of an IRR assessment, just like in the budgeting process. So the relevant question is—in addition to effective internal controls, oversight, and training, what can be done to ensure that the

modeling process is producing reasonably reliable risk assessments and projections with an acceptable degree of variance from actual results? From a regulatory perspective, the answer to this question is some form of a model validation procedure.

Regulatory Perspective

Regulators are increasingly focusing on procedures designed to minimize model errors resulting from inappropriate use of an IRR model. The concern is that incorrect results can lead to poor decision making, increased risk, and a lower degree of safety and soundness.[40] To address this concern, emphasis is now being placed on the validation process.

The regulatory perspective on validations arises in the form of advisory papers, regulations, and examiner guidance. To see the regulatory scope of the validation process, consider the following comments in an advisory by the FFIEC on internal controls and validation:

> *The regulators expect institutions to have an adequate system of internal controls to ensure the integrity of all elements of their IRR management process, including the adequacy of corporate governance, compliance with policies and procedures, and the comprehensiveness of IRR measurement and management information systems. These controls should be an integral part of the institution's overall system of internal controls and should promote effective and efficient options, reliable financial and regulatory reporting, and compliance with relevant laws, regulations, and institution policies.*[41]

The FFIEC advisory goes on to say the following regarding validation:

> *Validating IRR models is a fundamental part of any institution's system of internal controls. An important element of model validation is* ***independent review*** *[author's emphasis] of the logical and conceptual soundness. The scope of the independent review should involve assessing the institution's measurement of IRR, including the reasonableness of assumptions, the process used in determining assumptions, and the backtesting of assumptions and results. Management also should implement adequate follow-up procedures to monitor management's corrective actions. The results of these reviews should be available for the relevant supervisory authorities.*
>
> *Smaller institutions that do not have the resources to staff an independent review function should have processes in place to ensure the integrity of the various elements of their IRR management processes. Often, smaller institutions will use an* ***internal***

> ***party*** *[author's emphasis] that is sufficiently removed from the primary IRR functions or an external auditor to ensure the integrity of their risk management process.*[42]

Against this background, in February 2012 the NCUA issued 12 CFR Part 741, a new IRR regulation that became effective September 30, 2012. Under the "Internal Controls" section, the regulation states the following:

> *Internal controls are an essential part of a safe and sound IRR program. If possible, separation of those responsible for the risk taking and risk measuring functions should occur at the credit union.*
>
> *Staff responsible for maintaining controls should periodically assess the overall IRR program as well as compliance with policy. Internal audit staff would normally assume this role; however, if there is no internal auditor, management or a supervisory committee that is* ***independent of the IRR process*** *[author's emphasis] may perform this role. Where appropriate, management may also supplement the internal audit with outside expertise to assess the IRR program. This review should include policy compliance, timeliness, and accuracy of reports given to management and the board.*[43]

The regulation provides additional guidance for large credit unions with complex or high-risk balance sheets. These credit unions have assets greater than $500M. In this regard, the regulation states the following for such institutions:

> *The credit union* ***should consider*** *[author's emphasis] the following:*
>
> - *A policy which provides for the use of outside parties to validate the tests and limits commensurate with the risk exposure and complexity of the credit union;*
> - *IRR measurement systems that report compliance with policy limits as shown both by risks to earnings and net economic value of equity under a variety of defined and reasonable interest rate scenarios;*
> - *The effect of changes in assumptions on IRR exposure results (e.g., the impact of slower or faster prepayments on earnings and economic value); and*
> - *Enhanced levels of separation between risk taking and risk assessment (e.g., assignment of resources to separate the investments function from IRR measurement, and IRR monitoring and oversight).*[44]

In the process of issuing rules and regulations, regulatory agencies provide examiners with guidance for the examination phase. With respect to the validation process, it is insightful to examine the guidance provided by the NCUA to its field examiners in the form of an IRR review questionnaire:

> *The third party validation of the credit union's ALM model is considered a best practice. Models can be validated through a variety of methods. Each method is applicable to all three stages of the modeling process, input, processing, and reporting.*
>
> *Large credit unions with complex balance sheets should have formal policies regarding model validation. Validating the model, and backtesting or benchmarking high-risk balance sheet items will provide reasonable risk mitigation and provide assurance that a model is operating as intended.*
>
> *The three most common methods of model validation are* ***independent reviews, comparisons with other models, and comparison of model predictions with subsequent real world results*** *[author's emphasis].*[45]

In addition to such guidance, regulators send letters to institutions under their jurisdiction. Consider a letter to federally insured credit unions by the NCUA in response to a frequently asked question:

> *Does my model require an outside validation?*
>
> *Model validations can be performed by* ***either internal or external parties*** *[author's emphasis]. Validating IRR models is a fundamental part of a credit union's system of internal controls. An important element of model validation is independent review of the logical and conceptual soundness. The scope of the* ***independent review*** *[author's emphasis] should involve assessing a credit union's measurement of IRR, including the reasonableness of assumptions, the process used in determining assumptions, and the backtesting of assumptions and results. Smaller credit unions that do not have the resources to staff an independent review function should have processes in place to ensure the integrity of the various elements of their IRR management processes. Often,* ***smaller credit unions will use an internal party that is sufficiently removed from the primary IRR functions*** *[author's emphasis] or an external auditor to ensure the integrity of their risk management process.*[46]

The methods of validation require that they be thoroughly understood by analysts and risk managers. In the following section these methods are analyzed in detail and in light of regulatory guidance and expectations.

Validation Procedures

The three validation procedures cited above are relatively new to some financial institutions and range from a "best practice" to a rigid requirement. They pose many implementation and terminology questions that must be addressed. In this section an overall validation framework will be developed by examining each of the three procedures and related issues. To complicate matters, in the absence of a coherent and consistent validation framework, different institutions are likely to be held to different validation standards as well as being subjected to different "recommendations" by examiners. Depending on the particular approach and how it is used, the validation procedure can be a time-consuming and expensive process that raises as many questions as it answers, or it can be a valuable analytical tool that elevates the quality of the IRR management process.

Independent Review

The first procedure to be examined is the so-called independent review, which is a source of questions and considerable confusion. The FFIEC advisory above points out that an important element of such a review is to ensure the logical and conceptual soundness of the institution's ALM process. This includes examining the measurement procedures, reasonableness and development of assumptions, backtesting results, and policy compliance. The results of such a review should be in writing and available for review by examiners.

The term "independent" seems to imply that an outside party is necessary to examine the institution's ALM process. Indeed, the NCUA regulation cited above indicates that large credit unions (over $500M in assets) with complex or high-risk balance sheets should consider an outside party to validate the risk assessment process. Although this guidance appears straightforward, questions arise. For example, what if a large credit union is not complex? Holdings of mortgage loans are usually deemed to be high risk but at what level? If a smaller institution (under $500M in assets) is deemed to be complex, will it have to incur the time, effort, and cost of an external validation?

In practice, it is likely that a hard line will be drawn at the $500M mark. That is, large institutions may be required to have this validation performed by an outside, independent party. The fates of those institutions under this threshold are likely to be determined on a case-by-case basis by examiners.

The term "independent" does not always mean that an outside, third party must conduct the review. The guidance cited in the previous section states that such a review may be conducted *internally* in the case of smaller institutions provided that the reviewer is sufficiently removed from the IRR management function, especially risk taking. In this sense, an internal auditor may be a logical choice to conduct an internal review. However, a compliance officer or a member of the board, audit, or supervisory committee would also be able to perform this task on an independent basis provided that he or she is removed from the IRR management process.[47] However, it is critically important that the reviewers have knowledge of IRR management theory, principles, assumptions, and how these concepts are applied in ALM modeling.

Second Opinion

The second validation approach cited in the NCUA guidance for examiners is the comparison of model results with those of other models. This is known as a second opinion. Presumably, if the second opinion results are similar to those of the in-house or outsourced analysis in terms of the risk metrics, it is reasonable to conclude that the institution's modeling is appropriate. On the surface this seems straightforward. However, this is not always the case, because there is a difference between validating a model's results and validating the IRR profile. The focus should be on the latter.

To see this problem, a second opinion can be performed in two ways. One comparison may show similar results due to similar behavioral and valuation assumptions in the two models.[48] But in another comparison, if the second opinion provider has the discretion to use more aggressive or more conservative valuation and behavioral repricing or NMD valuation assumptions, the results will undoubtedly be different and they may or may not validate or be consistent with the institution's IRR assessment.

The key point here is that when a second opinion is used for the purpose of validation, management must be very explicit in its goal. If the goal is to validate the model, management should direct the second opinion provider to use the same or very similar underlying assumptions as in the institution's model. If the goal is to validate the IRR assessment, management should consider directing the second opinion provider to use its discretion and judgment in setting the assumptions. To the extent that there are meaningful differences in the results, the underlying assumptions can then be evaluated for reasonableness or possible revision. A more complete analysis would be to conduct the analysis both ways, that is, to validate the model itself *and* the IRR assessment utilizing outside expertise.

If the goal is to validate the model, the second opinion provider should use the same or very similar underlying assumptions as in the institution's model. If the goal is to validate the IRR assessment, management should consider directing the second opinion provider to use its discretion and judgment in setting the assumptions.

Because a second opinion can be a time-consuming and expensive project, care must be exercised for several reasons. Differences may arise in the results, so it is critically important to understand their source. Input errors and unreasonable or incorrect assumptions are common explanations. There is a tendency to place blind faith in a second opinion, but this raises the rhetorical question—who is going to validate the validator's risk assessment?

Another issue to be aware of regarding second opinion providers is a potential conflict of interest. For example, is the second opinion provider a competitor of the institution's ALM provider? If so, are the internal results questioned and the second opinion made to look more favorable using aggressive assumptions in order to get the institution's business?

Backtesting

The third validation procedure—backtesting—is perhaps the most important means of determining whether a model is being used properly and performing as it should. In this approach, subsequent actual results are compared with the model's predicted results. Such an analysis may be made by comparing actual principal cash flows with those generated by the model for present value and economic value computations. Another approach is to compare the actual interest income, interest expense, and the NII with those generated by the model. Since the objective of an ALM analysis is to assess an institution's income performance in different interest rate scenarios, it makes sense to focus on these components. This approach is the litmus test of an ALM validation.

If the ALM model is properly specified in all respects—inputs, assumptions, and free of material data and model errors—the resulting projected values are likely to have acceptable variances from actual values. Similarly, it is also likely that the underlying cash flows—principal and interest on the assets and liabilities—are reasonably estimated for the purpose of calculating the present values, both current and shocked, for use in determining the market values.

Since backtesting is listed as one of the three validation procedures, this suggests that it may be used as a stand-alone procedure or in conjunction with the independent review. Recall that the NCUA IRR regulation cited earlier states that a large credit union (over

$500M in assets) should consider a policy that provides for the use of outside parties to validate its risk assessment. *An effective, well-documented backtesting procedure should be an integral component of the ALM process. It should provide convincing evidence that the ALM modeling is appropriate with acceptable variances in the actual versus the projected results and be subject to review, internally or externally.* Thus, a cost-effective validation approach may be to combine a backtesting procedure with an independent review of the ALM process and modeling. In the event an external, third-party independent review is required by regulators due to size, complexity, or any other reason, the backtesting analysis could be included as supporting documentation in the material provided for that review.

A cost-effective validation approach may be to combine a backtesting procedure with an internal or external independent review of the ALM process and modeling.

Although the focus of this chapter is on validation procedures in a regulatory context, there is an equally important issue regarding backtesting. Since IRR models monitor a critical component of enterprise risk and one of the primary sources of institutional compensation, it is a sound practice to periodically backtest such models to ensure that they are steering the institution on a proper course.

Other Validation Issues

System Audit

In the preceding discussion the focus was on validation at the institutional level. However, there is yet another level that is required pursuant to the FFIEC advisory cited earlier:

> *Institutions that use vendor-supplied models are not required to test the mechanics and mathematics of the measurement model. However, the vendor should provide documentation showing a credible independent third party has performed such a function.*[49]

This means that the technical functionality of the ALM system should be audited by a qualified and reputable third party and a corresponding audit letter provided to the user. Such an audit requires an in-depth knowledge of the system.

Replicating Past Results

As pointed out earlier, the purpose of backtesting is to determine whether the model is capable of replicating the results of past events and rate scenarios. If interest rates on the short end of the curve are unchanged by the Fed for an extended period, the projected

results would then be based on a no-rate-change environment and then compared with the actual results. However, if short rates increased, say, 150 bps over a six-month period, resulting in a flat yield curve, the backtesting exercise would then be conducted retroactively using those parameters. In situations such as this, the results may show greater variance than normal but not necessarily because of incorrect modeling. The current circumstances may be such that the repricing strategy has changed from that of the initial modeling assumptions. This is an important point—past strategies or modeling assumptions should not be viewed as handcuffs tying the institution to those earlier strategies, since they may no longer be appropriate in the new environment. In other words, variances are not always a sign of modeling weakness. Judgment plays a role in these situations, and this is not always subject to validation.

Backtesting NII versus Cash Flows and Economic Value

As suggested earlier, a recommended backtesting procedure is to focus on the projected monthly interest income, interest expense, and NII versus actual results. Since the primary goal of an IRR assessment is to estimate the balance sheet's earning power under different rate scenarios, the primary focus of backtesting should be on the impact of changing rates on the NII. To the extent that the variances are within acceptable limits, it is reasonable to assume that the cash flows underlying the NII are properly estimated as well.

The most significant and unpredictable swings in balance sheet cash flows are usually associated with prepayments in the loan portfolio. However, the loan portfolio is only a portion of the balance sheet and its overall income-generating potential. As such, variances between actual cash flows and projections represent only a partial indication of modeling capability. Stated another way, *these cash flows provide an incomplete picture of the overall modeling procedure, whereas income simulation encompasses the entire balance sheet and its earning power.* Determining the income-generating capacity of the current balance sheet and its structure under different rate scenarios is the primary purpose of an ALM assessment.

Variances between actual cash flows and projections represent only a partial indication of modeling capability.

Estimated loan prepayments, especially on mortgage loans, may cause the effectiveness of ALM modeling to be questioned. Such prepayments manifest themselves completely in the month they occur, whereas the income effect occurs gradually over time.[50] This is not to say that backtesting cash flows from loans should not be conducted. Rather, it is important to understand the limitations of this form of backtesting.

The NEV, current or shocked, cannot be backtested directly, as is the case with interest income and expense. Rather, its analytical components—the actual cash flows of the loans and investments—may be compared with the projected values used in the present value calculations for NEV purposes. Such comparisons are very useful when fine-tuning the model, especially prepayment estimates and thus loan runoff. For example, if projected cash flows are consistently too high on mortgage loans and/or MBSs, an adjustment in the estimated prepayment speed may reduce the cash flow variances and bring the actual and predicted cash flows into better alignment and fine-tune the resulting valuations.

Examining the behavior of individual bonds with call options is another procedure that can be used to ensure that such instruments are properly specified and respond as expected in the rate environment, current or shocked. When such bonds are "in the money," this means that the model's cash flows should properly reflect that they would be called by the issuer because the market rate (current or shocked) is below the coupon on the bonds. In other words, the bonds can be called at their next call date and reissued at a lower cost to the issuer. When the bonds are "out of the money," the model should reflect that they would not be called, since the issuer's replacement cost would be higher than the coupon rate.

Causes of Forecasting Variances

When the backtesting focus is on interest income, interest expense, and NII, the causes of variance beyond random "noise" must be understood. The reason is that significant variances may be incorrectly attributed to inappropriate use of the model. Although model error is always a possibility, there are other factors at work that can cause unusual or unexpected variation in the actual interest income, interest expense, and NII. Some of the variances have nothing to do with the model and may be explained, or adjustments may be made in the modeling process.

Model error is always a possibility, but there are other factors at work that can cause unusual or unexpected variation in the actual interest income, interest expense, and NII.

Interest Income and Interest Expense Data

The actual interest income can vary significantly from month to month for several reasons, one of which can be accounted for in the modeling process. This is the number of days in the month in concert with the proportion of interest income from certain loans and investments that accrue interest on a 30-day basis as opposed to daily interest. This variation can be modeled since the parameters are known with certainty.

Another major but unknown source of interest income variation is the impact of delinquent loans going into a nonaccrual status subsequent to the ALM analysis. When this happens, the accrued interest over the prior 90 days is reversed in that month *and* income is no longer accrued for that month and going forward until the loans are restored to accrual status after six months of timely payments. Similarly, when such loans return to an accrual status, the income from prior months suddenly reappears in that month's income stream. Such events are an irregular and unknown source of variance and are unavoidable. This is not model error—it is a natural product of forecasting. Other variances may arise due to retroactive adjustments to interest income on government-backed student loans.

Depending on the balance sheet composition, virtually all of the interest expense is based on the number of days in the month, so it will vary accordingly and significantly from month to month. However, in a stable rate environment, an unexpected source of volatility may arise if deposit rates are changed subsequent to an ALM analysis. Changing the rate on an MMA, for example, could have a meaningful impact if a significant change is applied to a large balance.

Both interest income and expense can be affected unexpectedly if the balance sheet itself is subjected to material and unexpected changes, such as a restructuring involving the sale or purchase of investments or other earning assets.

Data Errors

Another source of variance results from data errors. In addition to routine input errors that may or may not be material, data errors may arise when loan data files are downloaded into an ALM system. Interestingly, the quality of downloaded data is rarely questioned and the data are virtually always presumed to be free of errors. Such blind faith may not be justified. Consider the results of a study that analyzed loan data files used in balance sheet risk assessments:

> *Over the last three decades, FTN Capital Assets has analyzed thousands of data files as well as underwritten and reviewed hundreds of thousands of loan files across multiple loan product types. The one constant we have observed across these diverse and extensive reviews is that the data being used for the analysis is incapable of being relied on without first verifying its accuracy. The reason is the high degree of either incomplete and/or incorrect information we have seen consistently. This issue is so prevalent that* ***a 30% error rate in the data is considered very good*** *[author's emphasis].*[51]

The study did not mention the nature of these errors or their materiality. An error rate of 30% is surprising, to say the least. However, even when the downloaded loan data are scrubbed to perfection, yet another issue immediately arises to cause the projected, future cash flows of principal to have a high degree of volatility and uncertainty. Like the claw-back of accrued interest, this effect is unavoidable, so it is a cause of variances that are a normal component of forecasts. This problem arises because of prepayment assumptions.

Prepayment Assumptions

Virtually all loans may be prepaid by the borrower. Since the timing and amounts of these prepayments are unknown, they are not reflected in data files downloaded from a core system. ALM models take these transactions into account by applying estimates of *future* prepayment behavior to the loan data. These estimates may be based on the institution's recent history or the recent experience of MBSs or certain asset-backed securities that are publicly traded. Ironically, although both approaches are generally accepted, neither is likely to produce accurate results on a consistent basis unless the estimates are applied to extremely large pools of loans (at least 300 or 400) and the economic and interest rate environments are relatively stable. In other words, future experience will often vary considerably from estimates for reasons that are unknown at the time of the analysis.

To see the nature of this problem, consider a pool of mortgage loans in which the loan data files project the actual stream of future contractual payments. Depending on the size of the loan pool, it may reflect a high degree of volatility in the future principal cash flows due to the behavior of just a few loans prepaying. This can result in a temporarily high annualized prepayment speed that is meaningless. Similarly, if no loans prepay for a period of time, as is often the case involving a relatively small loan pool, the annualized prepayment rate may be equally irrelevant at zero. Using national prepayment data based on MBSs containing a very large number of loans may be an acceptable and reasonable compromise. However, the projected cash flows will most likely be inconsistent with the actual data, reflecting either a very high prepayment speed or zero. Clearly, this can be another unavoidable source of backtesting variance on cash flows.[52] This problem is especially acute in smaller institutions and/or smaller loan portfolios, where the performance of only a few loans can lead to unreasonable assumptions and significant variances between actual and projected results.

There is yet another issue regarding prepayments that greatly alters or distorts the data from what might be an otherwise perfect, downloaded loan file. That is, prepayments, both actual and estimated, usually overwhelm certain data in a downloaded file. This means that cash flows from prepayments can far exceed contractual cash flows. To see this, consider the greatly simplified example of an *unseasoned* $1M pool of 5%, fixed-rate mortgage loans with 30-year amortization terms.[53] The contractual monthly payment from this pool would be $5,368, of which $1,201 is the scheduled principal payment in the first month and

supposedly known with certainty. However, if an annualized prepayment rate of, say, 12% (or 1% per month) is assumed, the *estimated* principal cash flow in month one will now be $1,201 plus 1% of the month-end balance of $998,799, or $9,988, for a total of $11,189. Note that this principal cash flow completely overwhelms the contractual portion by about nine to one. What was thought to be a cash flow known with certainty is now only an estimate and not necessarily a good one.

Any prepayment estimate carries the risk of considerable forecast error.

Now consider what happens if the actual prepayment experience turns out to be 20%. In this case, the contractual principal payment plus the prepayment is $1,201 + [(.20/12) × $998,799] = $17,848. Again, this overwhelms by almost 5 to 1 the scheduled payments as they would appear in the loan file. The point here is that the dominant determinants of the projected cash flows for mortgage loans are the amortization term coupled with the prepayment estimate, which is itself subject to considerable and unavoidable forecast error that can overwhelm the presumed accuracy of cash flow data from the loan file.

The impact of incorrect prepayment estimates on shorter-term loans is less dramatic. Consider the simplified example of a $1M pool of unseasoned 5%, five-year auto loans. The contractual monthly payment from this pool would be $18,871, of which $14,704 would be the scheduled principal payment in the first month. Assuming a 15% prepayment speed, the contractual principal payment plus the prepayment would be $14,704 + [(.15/12) × $985,296] = $27,020. This is only about twice the scheduled principal payment of $14,704. This simple example demonstrates that the impact of prepayment estimates is considerably less on short-term loans because such a large portion of the monthly payment is the required contractual payment, in contrast to mortgage loans.

The nature of loan prepayments is such that they can vary considerably from month to month and cause significant variation in the actual cash flows versus the projected flows. Therefore, when backtesting cash flows from loan portfolios, significant variances can be expected. But as pointed out earlier, the impact of such variances on actual interest income may be considerably less in the very near term because the full income effect usually evolves gradually over time. The full projected income effect of such prepayments and how those funds are redeployed will be picked up in the next ALM analysis, usually one to three months hence.

To further complicate backtesting cash flows, in recent years the normal historical relationship between prepayments on mortgage loans and the level of market interest rates has been disrupted by a decline in housing values and the resulting loss of equity coupled with widespread declines in the credit scores of borrowers. Many individuals with

higher-coupon mortgage loans who would ordinarily refinance to get a lower rate were unable to do so. This has complicated the prepayment estimation problem and how it affects cash flows and variances in the backtesting process.

The normal historical relationship between prepayments on mortgage loans and the level of market interest rates has been disrupted by a decline in housing values and the resulting loss of equity coupled with widespread declines in the credit scores of borrowers.

Changes in Pricing Strategy

A source of variance is likely to arise from time to time due to unanticipated changes in pricing strategies subsequent to an ALM analysis. One of the more significant of these effects arises from the repricing of NMDs, especially the MMA due to its size and the immediate income effect of changes in rates. Similarly, if lower (or higher) rates on CDs, for example, are applied to a large amount of maturing balances, this may result in larger variances. However, it is important to recognize that such variances are *not* due to model error, since the change in pricing strategy was not known at the time of the analysis. When analyzing significant variances it is critical to distinguish between what is known and what is unknown at the time of the ALM analysis.

Forecasting Horizon

When attempting to determine an acceptable level of variance between actual results and projections in the backtesting process, it is important to keep in mind that variances are likely to be larger as the forecasting horizon extends. This is a normal result of the forecasting process, so judgment must be exercised when examining the more distant projections.

CHAPTER 6

Conclusion

The IRR problem confronting depository institutions is complex. After more than three decades of declining interest rates that reached historically low, manipulated levels, the stage may be set for a period of financial stress due to rising interest rates. In this regard, the lingering memories of the S&L crisis hang over depository institutions and their

regulators like the Sword of Damocles. Even when rates return to only "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 short-term interest rates at unusually depressed levels for an extended period, as it has indicated in its policy pronouncements, the NIMs of some institutions may be under 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 report has demonstrated, the IRR measurement problem has many facets. 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, multiperiod 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 percentage change and the basis point change should be related to capital. But the NEV methodology has limitations. It does not focus *explicitly* on income performance or its impact on regulatory capital. Furthermore, the NEV may be significantly affected by the assumptions used to determine the theoretical value of NMDs. Finally, it provides little or no explicit income-related insight in a stable or falling rate environment.

Both an NEV analysis and an extended, multiperiod income simulation analysis are necessary to interpret IRR signals.

For these reasons, such an analysis must be augmented by an extended, multiperiod 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 demonstrated in this report, the greater the IRR, the greater the need for an extended, multiyear income simulation procedure. Furthermore, the quantitative aspect of the ALM process must be augmented by a strong qualitative component with proper training, controls, governance, and some form of validation.

The quantitative aspect of the ALM process must be augmented by a strong qualitative component with proper training, controls, governance, and some form of validation.

The focus of this report has been on the IRR resulting from the structure of assets and liabilities. But there are other facets of IRR that may not show up in an ALM analysis that should be considered as well. For example, some institutions originate and sell a large volume of mortgage loans due to refinancing during periods of low or falling interest rates, thus generating substantial fee income. However, this income can quickly dissipate when rates increase, even if only moderately. This is not always recognized in an ALM analysis.

Another issue is the impact of rising rates on the creditworthiness of borrowers with variable-rate loans. In this situation the IRR has been shifted to the borrower, thus having the potential to increase credit risk. To the extent that borrowers have become adjusted—or addicted—to unusually low rates, this could be a problem even when interest rates return to more "normal" levels from the prolonged and manipulated, ultra-low rates imposed by the Fed in the aftermath of the Great Recession. This would require a qualitative assessment and yet another use of judgment when assessing this aspect of IRR.

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 at certain times some institutions may increase their IRR in an attempt to offset income pressure from an elevated level of loan losses, margin compression, weak loan demand, or unusually 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 also avoid regulatory problems and survive.

IRR modeling should reflect a margin of safety by taking into account several aspects of the history of interest rates. In Chapter 1, Figure 1 showed interest rates declining over a period spanning more than three decades to unprecedented low levels such that the premium for risk taking was correspondingly reduced in virtually all segments of the financial markets. Stated another way, the risk associated with rising interest rates has greatly increased relative to any other time in history, thus making financial institutions more susceptible to significant problems when interest rates increase. This is widely recognized. But there is an important and largely ignored element of this history characterized by that graph.

Over this prolonged stretch of declining rates beginning in the early 1980s, there were relatively short periods when short-term rates increased 200 to well over 500 bps. However, with the exception of those occurring in the early 1980s, these increases were not sustained and they were quickly followed by declines to even lower levels than those prior to the increases. The resulting income pressure due to high levels of IRR was short-lived,

and relief was quickly forthcoming. Thus, *financial institutions did not feel the full and potentially very adverse effects of these brief episodes. This means that despite a much better understanding of IRR and more powerful analytical tools, financial institutions have not been tested in a prolonged period of rapidly rising interest rates that have been sustained at a high level.* The key here is the term "sustained."

Despite a much better understanding of IRR and more powerful analytical tools, financial institutions have not been tested in a prolonged period of rapidly rising interest rates that have been sustained at a high level.

Numerous circumstances could bring about such a test in the future. Here are a few:

- A return to a more "normal" level of interest rates when the Fed ends its ultra-low interest rate policy.
- A stronger economy and lower levels of unemployment and underemployment.
- Significantly increased inflation or inflationary expectations.
- The loss of the US dollar's global status as the world's reserve currency.
- A continued deterioration in the long-term fiscal position of the United States and the emergence of the so-called bond market vigilantes.

The first three would hardly be considered black swan events, but the consequences may be similar for many institutions. The last two are evolving, longer-term concerns but with potentially devastating consequences for the global economy as a whole and financial institutions in particular. The key point here is the need for effective IRR management and building in a margin of safety in the modeling process. To paraphrase a long-standing caveat in the investment community—past success (in managing IRR) is not a guarantee of future performance.

Endnotes

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 on new commercial business and fraud played major roles 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 subprime 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 $188 billion (B) by late 2012. 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 held about $1.5 trillion in fixed-rate mortgage loans on their balance sheets, it was 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 ongoing 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 were an ideal way for the issuers 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?

2 Some analysts might define ALM in a much broader sense to encompass virtually all aspects of financial management, including credit risk. However, for the purpose of this report, the narrower definition, focusing only on IRR, 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 in order to compete was initially hampered by the infamous Regulation Q, which 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. The process of "disintermediation," therefore, 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.

4 NEV is also referred to as the economic value of equity and net portfolio value. The term "NEV" will be used in this report.

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 warrants additional attention, as discussed later.

7 This approach is a rough proxy for liquidation value because the focus is only on the impact of interest rates on valuation. In practice, many other factors affect liquidation value. For example, haircuts on bad loans that may have precipitated the liquidation or on the forced sale of fixed assets may cause major discrepancies between the NEV numbers and actual liquidation values.

8 The OTS was merged into the Office of the Comptroller of the Currency (OCC) in July 2011. The OCC regulates all federally chartered banks. The future use or application of this model by the OCC is unknown.

9 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 on the basis of 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 percentage of assets. When this ratio exceeds 25%, more attention is focused on IRR. (This ratio may also be expressed as a percentage of net worth.) It is important to note that these tests focus only on the asset side and that they are *not* definitive risk measures. Rather, the results are used by regulators to allocate resources or to determine whether 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.

10 The NMD issue is discussed in more detail in a subsequent chapter.

11 The impact of a changing NII on NI is important as well. But the NI is also affected by operating expenses, loan loss provision expenses, 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 chapter, which deals with an analysis of the S&L industry.

12 FFIEC (Federal Financial Institutions Examination Council), *Advisory on Interest Rate Risk Management*, January 6, 2010, p. 4, http://www.fdic.gov/news/news/press/2010/pr1002.pdf.

13 The average maturity of CDs was 14.9 months and 23.5 months for borrowings.

14 The characteristics of these accounts are discussed in detail in Chapter 4.

15 This procedure reflects both a flattening 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.

16 All analytics in this report were performed using the CU/ALM-ware System (version 9.1), which was developed by the author's firm.

17 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 book values. The resulting shocked NEV was –5.76% and the percentage change was –192% versus –5.17% and –182%, respectively. The "improvement" shown in Figure 8 using the theoretical NMD valuation is a result of the three-year average life assumption on the savings account coupled with the assumption that the savings rate would increase by

80% of the rate shock with a one-month lag. The conclusion regarding an extraordinary degree of IRR is obviously unaffected by the NMD assumptions in this case.

18 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 the principal. However, this reluctance can be overcome depending on the extent of income improvement. It is very likely that increases in rates of 400 bps or more over relatively short periods would be sufficient to induce this process. This is what happened in the S&L crisis.

19 This analysis was conducted using the CU/ALM-ware System (version 9.1).

20 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 long-term investments could be hampered by the realization of losses in a rising rate environment.

21 As demonstrated in the next chapter, the speed of income recovery is a critical but largely neglected component of an IRR assessment. This is an important lesson that should have been learned from the S&L debacle. The losses were so large that the S&Ls ran out of both capital and time.

22 See John R. Brick, *Interest Rate Risk & Auto Loan Portfolios*, January 2014, brickinc.com/Portals/0/Interest%20Rate%20Risk%20and%20Auto%20Loan%20Portfolios.pdf.

23 In discussions about the impact of rising interest rates on depository institutions, the magnitude of such increases is usually the focus of attention. However, in practice, the speed or time frame over which the increases take place is also a critical component. For example, an increase of 300 or 400 bps in short-term rates by the Fed over a 12-month period would be one thing. But if the increase occurred over two or three years, the income results would be quite different because the asset returns would have more time to adjust to the new rate environment.

[24] This is known as the "naive forecast," and it is used to minimize forecast errors. It is well recognized that rates may change, and incorrectly estimating the direction, timing, and magnitude of a forecasted change may greatly magnify budgeting variances or forecast errors. Thus, the naive forecast is commonly used.

[25] Although the balance sheet may be allowed to change over time in order to simulate income performance, the resulting NII risk profile would *not* be related to the NEV results or the related IRR policy guidelines for the change in the NII that is based on the current or existing balance sheet, which is at a point in time. Furthermore, the FFIEC has expressed concern about this practice since model assumptions may mask underlying exposure. See FFIEC, *Advisory on Interest Rate Risk Management*, p. 4.

[26] See FFIEC (Federal Financial Institutions Examination Council), *Interagency Advisory on Interest Rate Risk Management: Frequently Asked Questions*, January 12, 2012, p. 4, www.ffiec.gov/PDF/01-12RR_FAQs.pdf.

[27] The comments on reliability relate to the NEV and its counterpart, the NII. When extending the NII to reflect the possible impact on NI and statutory capital, long-term estimates of fee income, operating expenses, and loan loss provision expenses must be made. Clearly, long-term estimates of these inputs may not be reliable and must be regarded accordingly. But even using rough estimates or ranges of these components based on historical performance allows risk managers to get a sense of the potential pressure on NI and, ultimately, capital.

[28] Even if a balance sheet grows over time, its risk is unlikely to change in a material way within a typically short interval between ALM analyses unless there is a major restructuring. In fact, if the balance sheet grows but the product mix and structure are unchanged (as is often the case in a short interval), the IRR is likely to be unchanged as well.

[29] Using an immediate shock test for income simulation purposes appears to run counter to the FFIEC recommendation that shock testing be "severe but plausible." See FFIEC, *Advisory on Interest Rate Risk Management*, p. 5. One can only imagine the global financial chaos that would result from an immediate increase of 300, 400, or 500 bps by the Fed. Equally important from the standpoint of managing IRR is that the results of such a procedure lack credibility among risk managers. A reasonable ramping procedure easily overcomes this problem and provides a more reasonable

representation of projected earning power. Since an NEV analysis is a valuation problem, immediate shock testing must be used and is appropriate to determine the potential impact of changing rates on the balance sheet values.

30 The degree of rate sensitivity of the passbook accounts at that time is unknown. However, the size of this account coupled with the lack of an MMA resulted in the commingling of non-rate-sensitive and rate-sensitive funds, thus sensitizing the entire account. This is why a high degree of rate sensitivity was assumed. Subsequent liquidity problems justified this assumption. A separate simulation was conducted using an increase of 50% of the rate shock. The disastrous risk measures improved somewhat, but the conclusions regarding the extraordinary level of IRR were unchanged.

31 FFIEC, *Advisory on Interest Rate Risk Management*, p. 5.

32 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 0%–0.25% for an extended period.

33 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 nonexistent, so there was little in the way of precedent for how these loans would perform from a credit standpoint in the event of a significant and sustained increase in rates. However, both evidence and common sense suggest that under certain conditions, IRR and credit risk could interact in an adverse way.

34 The OTS estimated these servicing costs as follows: 1.80% for checking accounts, 1.39% for savings accounts, and 0.86% for MMAs.

35 As George Will said, “History always repeats itself, until it doesn’t.”

36 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.

[37] 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 measurement error is to assume a higher degree of rate sensitivity for the entire account.

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

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

[40] These are obvious concerns resulting from model errors. However, it is less obvious that inappropriate use may also overstate risk and cause the institution to underperform from an income standpoint since risk bearing—credit risk and IRR—is an essential source of institutional compensation.

[41] FFIEC, *Advisory on Interest Rate Risk Management*, p. 8.

[42] Ibid.

[43] 12 CFR Part 741, Fed. Reg., Vol. 77, No. 22, p. 5155 (Feb. 2, 2012).

[44] Ibid., p. 5166.

[45] NCUA, *IRR Review Questionnaire (Cell A154)*, www.ncua.gov/Resources/CUs/ALM/Pages/ALMReview.aspx.

[46] NCUA, *Interest Rate Risk Policy and Program Frequently Asked Questions*, Letter No. 12-CU-11, August 2012, www.ncua.gov/Resources/Pages/LCU2012-11.aspx.

[47] A supplemental validation procedure for such reviews, backtesting, is explained below. When properly used, this validation procedure may go a long way in satisfying the regulatory guidance when combined with an independent review, internal or external.

[48] Among the more important assumptions that can cause comparisons to vary considerably are those underlying the valuation of NMDs, repricing behavior by management in different rate scenarios, and prepayment assumptions. Errors can also cause discrepancies. However, side-by-side comparisons conducted by the author's firm show that when the same data and assumptions are used, the results from different systems are very similar or virtually identical.

[49] FFIEC, *Advisory on Interest Rate Risk Management*, p. 8.

[50] Not all prepayments have an immediate and meaningful income effect. For income simulation purposes, a common assumption is that cash flows are reinvested back into that product at current market rates. If these rates are below the portfolio rate, the income will decline but gradually over time, reflecting the difference between the rates on the prepaid assets and the reinvestment rates. Although prepayments often have a significant effect on income over time, the impact is not always material in the short-term, that is, in the interim between ALM analyses. This effect, material or otherwise, will be reflected in a subsequent ALM analysis, which usually occurs on a monthly or quarterly basis.

[51] FTN Financial Capital Assets Corporation, *Garbage in/Garbage out: The Importance of Complete and Correct Loan Data*, February 1, 2012, p. 1.

[52] The prepayment problem discussed in this section may have a significant impact on the cash flow variances but less so on the near-term income simulation variances. As pointed out earlier, for income simulation purposes a common assumption is made that such cash flows are redeployed into the same product. This redeployment may occur at a lower rate due to refinancing, for example, but the near-term income effect is likely to be modest since its full effect occurs gradually and cumulatively over time (as more loans prepay), rather than immediately, as in the case of the sudden increase in cash flows from the prepayments.

[53] The mortgage loan and auto loan examples that follow are greatly simplified for expository purposes. In practice, the prepayment effect is more complicated than shown because portfolios contain loans with varying degrees of seasoning rather than unseasoned pools in the examples that follow. This seasoning is reflected in the ALM modeling process. For example, a *fully seasoned* auto loan portfolio would contain loans ranging from old loans with one payment remaining to new loans with up to 60 or 72 payments

remaining, depending on the amortization terms of the products offered. Prepayment assumptions are then applied to the portfolio. Similarly, modeling mortgage loan portfolios must take into account loans with different terms. The purpose of the simplified examples is to demonstrate how error-prone prepayment estimates can be and that they can be an unavoidable source of cash flow forecast errors.

List of Figures

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