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MATURITY INTERMEDIATION AND INTEREST RATE RISK: HEDGING STRATEGIES FOR S&Ls

BY

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ABSTRACT

Maturity Intermediation and Interest Rate Risk:
Hedging Strategies for S&Ls

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The fundamental result from portfolio theory is diversification reduces risk. This paper analyzes financial intermediaries' efforts to manage interest rate risk as a problem in choosing an efficient (diversified) portfolio. Many financial intermediaries and especially S&Ls have badly mismatched asset and liability maturity structures. The maturity mismatch exposes institutions to interest rate risk--the S&L industry recorded major losses in 1981 and 1982.

This paper analyzes the consequences of two popular techniques to hedge interest rate risk--gap management and variable rate loans--on the expected profits and risk in a simple portfolio. It shows these techniques reduce risk and expected profits. In contrast, futures hedging gives a more efficient portfolio that reduces risk without reducing expected profits. The final section of the paper presents simulation results for a hypothetical S&L that show a very conservative futures hedging strategy substantially reduces the losses that accrue to an unhedged portfolio over the period from 1977-1982.

Introduction

Two of the major functions of financial institutions are (1) the broker function where institutions match borrowers and lenders and (2) the maturity intermediation function where institutions take an intermediary position between the mismatched maturities of borrowers' and lenders' obligations. The pure brokerage function involves little risk since the institutions do not need to take a position, e.g., investment bankers frequently put together a pool of lenders to match a borrower's needs and receive a commission for their effort. Maturity intermediation involves risk because the institution takes a position. Usually lenders prefer to make short-maturity loans and borrowers prefer to take long-maturity loans. Financial intermediaries take a position by borrowing short from some agents and lending long to other agents. The maturity mismatch exposes the intermediary to interest rate risk. If short-term rates rise unexpectedly, their cost of funds rises immediately, but their income from long-term fixed rate assets only rises slowly as the assets mature and new loans are reissued at higher rates.

The upward drift in rates and the increased volatility in rates in the late seventies and the eighties increased interest rate risk. Saving & Loan institutions were particularly hard hit. S&L's hold a badly mismatched portfolio. The majority of their liabilities pay short-term market rates and mature in less than one year. Over 80 percent of their assets have maturities longer than one year and most of their assets are long maturity mortgages. The industry recorded major losses in 1981 and 1982 and barely returned to profitability in 1983.

The S&L industry has taken steps to reduce interest rate risk. It has tried to lengthen the maturity of its liabilities and reduce the maturity of its assets. Some S&Ls sell most of the mortgages they originate and rely on fee income from their brokerage service. This shifts the maturity intermediation risk to the buyer of the mortgage. Most tried to shift the interest rate risk to the borrower through variable rate mortgages. In 1984 more than 60% of mortgages closed had adjustable rates. These efforts reduce interest rate risk for the S&L by reducing the intermediation function of S&Ls. Although reducing risk is desirable, reducing maturity intermediation is neither socially desirable or necessarily in the S&L's interest. Part of the payment for S&L services is a payment for maturity intermediation and if S&Ls provide less service they will make less income and lose customers.

This paper examines a financial futures market strategy for S&Ls to hedge against interest rate risk while providing maturity intermediation. Organized financial markets are markets for risk sharing. The market guarantees contracts, and agents with different risk preferences or maturity habitats can trade contracts to diversify their risk position. This paper examines the consequences of adding a futures position to a typical S&L portfolio.

Section 1 presents a simple analytic illustration of the interest rate risk inherent in maturity intermediation. Section 2 reviews two popular hedging strategies--gap management techniques and variable rate mortgages--and compares them with futures hedging. Section 2 represents the hedging rules as a security selection problem in a traditional portfolio framework. In portfolio theory diversification reduces risk. An efficient portfolio is the set of securities that minimizes risk for a given expected rate of return. Section 2 shows that futures hedging gives an efficient portfolio. Gap management techniques and variable rate loans reduce risk, but also reduce expected returns. Section 3 presents empirical results. In practice, regulators and prudence would limit the size of S&L futures positions, and limited futures contracts restrict the feasible hedging horizon. We present simulation results for the period from 1977-1982 which show that a very conservative sequential futures hedging strategy could have cut losses for a hypothetical S&L by 70 percent. More aggressive strategies yield positive returns.

Section 1

In this section we consider a two-security portfolio to illustrate the expected profit and risk from maturity intermediation in the simplest case. Suppose the S&L holds an asset which is a fixed interest rate [i(n)] loan with a maturity of n years. The S&L finances the asset with a variable rate deposit (say a CD) that pays the market rate of interest i_t. Thus the S&L holds a self-financing two-security portfolio--one asset and one liability. The annual net interest income from the loan portfolio is

1.1 $$NII_t = i(n) - i_t$$

where we normalized the asset and liability value at one to simplify the notation.

The net interest income in any year is negative if the short rate exceeds the long rate; but, over the life of the loan the average net interest income

1.2 $$ANII = i(n) - \frac{1}{n} \sum_{j=0}^{n-1} i_{t+j}$$

is positive as long as the n-period rate exceeds the average of the one-period rates. Of course, the portfolio is risky since the short rates are unknown at the time the S&L makes the loan. (In practice, prudence and regulations require S&Ls to hold reserves on the risky loan portfolio. Arbitrage should reduce any profit from a riskless self-financing portfolio to zero.)

Expected return and standard deviation are statistics frequently used to describe a risky asset or portfolio. The expected profit on the two-security loan portfolio (LP) is a weighted average of the expected net interest income over the life of the portfolio,

$$E_t(LP) = E_t \sum_{j=0}^{n-1} w_j NII_{t+j} = \frac{1}{n} \sum_{j=0}^{n-1} E_t NII_{t+j} \tag{1.3}$$

where we choose equal weights for pedagogical purposes.[1] Decomposing the expected profit into gross interest income and expenses gives,

$$E_t(LP) = i(n) - \frac{1}{n} \sum_{j=1}^{n-1} E_t i_{t+j} \tag{1.4}$$

i.e., the expected profit at time t is spread between the long rate and the average of the future expected short rates. Equation 1.4 is the stochastic analogue of the average profit realization in equation 1.2. Equation 1.4 also can be interpreted as the expectations theory of the term structure by equating the expectations E_t with the market's subjective expectations of future short rates. Then, the residual expected profits in equation 1.4 represent the "liquidity" premium.

The S&L earns an expected liquidity premium for maturity intermediation. The nonbank public prefers to lend short and borrow long,

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[1]The income should be discounted by a time-preference factor where weighting varies with the interval until receipt. For our purposes, time discounting simply makes the notation messy and the analogies less obvious.

the S&L takes a position intermediating between the preferences of the nonbank public by accepting short-maturity deposits and issuing long-maturity loans. In return it earns a profit for the maturity intermediation service it provides.

The S&L may also expect to earn a speculative return if it believes the market's forecast of future short rates reflected in $i(n)$ are biased forecasts of the future short rates. For example, let i^e_{t+j} denote the market's expectation, then the n-period rate can be written as,

1.5 $$i(n) = \frac{1}{n} \sum_{j=1}^{n-1} i^e_{t+j} + l(n)$$

where $l(n)$ is the liquidity premium. The S&L's expected profits contain the liquidity premium plus a speculative profit,

1.6 $$E_t(LP) = l(n) + \frac{1}{n} \sum_{j=1}^{n-1} (i^e_{t+j} - E_t i_{t+j}) \equiv l(n) + \text{bias}$$

where the speculative profit depends on the bias in market expectations. Of course, all market participants can't beat the average, so the expected speculative return for the market must equal zero.

The standard deviation or risk from the loan portfolio

1.7 $$R(LP) = [E_t(LP-E_t LP)^2]^{1/2} = \frac{1}{n} [E_t(\sum_{j=1}^{n-1} (i-E_t i)_{t+j})^2]^{1/2}$$

only depends on the evolution of future liability rates since the gross income stream is known. The greater the volatility of one-period liability rates and the higher the serial correlation, the greater the risk.

To illustrate, with little loss in generality,[2] we can write the one-period rate as

1.8 $$i_t = m + \sum_{j=0} b_j e_{t-j},$$

a constant mean (m) plus a moving average of serially uncorrelated mean-zero errors (e). The b_j are constant weights that describe how quickly short rates revert to their mean after a shock. The forecast error in any period depends on the accumulation of the serially uncorrelated errors,

1.9 $$i_{t+j} - E_t i_{t+j} = \sum_{\ell=0}^{j-1} b_\ell e_{t+j}$$

The larger the shocks (the e_{t+j}) and the more persistent the effect of the shocks (i.e., the b_ℓ do not quickly go to zero), the greater the risk as the forecasting errors accumulate over the life of the fixed interest rate loan.

Substituting 1.9 into 1.7 gives the formula for the standard deviation of the loan portfolio,

1.10
$$R(LP) = \frac{1}{n} [E_t[\sum_{j=1}^{n-1} \sum_{\ell=0}^{j-1} b_\ell e_{t+j-\ell}]^2]^{1/2}$$
$$= \frac{1}{n} (\sum_{j=1}^{n-1} \sum_{\ell=0}^{j-1} b_\ell^2)^{1/2} \sigma_e$$

where $\sigma_e^2 = E(e^2)$.

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[2]Using Wold's decomposition, any stationary-stochastic process can be represented as a linear moving average, e.g., see Anderson.

Many of the S&Ls' misfortunes can be attributed to an increase in maturity intermediation risk. In the late 1970s and early 1980s, the volatility of all interest rates dramatically increased, i.e., the variance of the errors (the e) driving the interest rates increased. In addition, the term structure drifted upward as the market slowly revised its expectations about the persistence of inflation. As a result, S&Ls' earnings streams became riskier and profits fell far short of expectations due to the systematic underestimates of future short rates. The next section reviews risk reducing strategies.

Section 2: HEDGING

Traditional portfolio theory relies on diversification to hedge against unanticipated events while maintaining the maximum expected rate of return. An efficient portfolio is the combination of securities that achieves the minimum risk for a given expected rate of return. When the interest rate risk inherent in maturity intermediation increased in the late seventies, S&Ls and financial intermediaries in general reduced interest rate risk by issuing new instruments that reduced the effective maturity gap. Reducing the maturity gap reduces the risk, but it also reduces the expected return earned for maturity intermediation. This section compares "gap management," variable rate loans, and financial futures hedging strategies. It shows that gap management and variable rate loans reduce both the expected profit and risk, while futures hedging can reduce risk and leave the expected return unchanged.

Gap Management

Gap management is the most popular technique used by S&Ls and banks to monitor and manage interest rate risk. Gap techniques have a simple intuitive appeal. Gaps are a measure of an S&L's exposure to interest rate risk over the gapping period.

The gap is defined as the book value of asset flows (AF) minus the book value of liability flows (LF) to be repriced during a gapping interval

2.1 $$G_{t+k} = (AF-LF)_{t+k}$$

where k denotes the gapping period; e.g., if the gapping interval is a year and k=0, then the gap measures assets minus liabilities to be repriced in the coming year, or if k=1 the gap covers the interval from one to two years in the future. Most institutions emphasize the nearby gaps because they care most about earnings in the immediate future.

Choosing a year for the gapping interval, the gaps from the two security loan portfolio in Section 1 are

2.2 $$G_{t+k} = \begin{cases} -1 & k = 0, \ldots, n-2 \\ 0 & k = n-1 \end{cases}$$

During each period the liability matures and is repriced (a new CD gets issued at the market interest rate); whereas the asset only is repriced when the loan has been repaid after n years. Over the life of the loan the portfolio has gap of -1 (the book value of the CD issued each year) for n-1 years and a zero gap the final year when both the asset and liability mature. The gap measures the S&L's exposure to interest rate risk in terms of the net flow of funds subject to interest rate risk in the gapping interval. The gap provides a measure of exposure, but not a direct measure of the "riskiness" of earnings. The standard deviation of portfolio profits in equation 1.7, on the other hand, gives a direct measure of the variability in earnings. The portfolio profit standard deviation also depends on the sum of n-1 terms reflecting the repricing of the liability. The standard deviation of profits, however, directly links the variability in interest rates to the variability in earnings.

Gap management techniques suggest hedging interest rate risk by altering the net flow of funds exposed to interest rate risk, i.e., they suggest matching the repricing schedules of assets and liabilities. Consider an alternative two security loan portfolio with all gaps set to zero. The gaps can be set to zero by selecting an asset with a shorter maturity or a liability with a longer maturity.

Suppose the S&L chooses a deposit with an n-period maturity. The expected profit from the zero gap portfolio (ZGP) is

2.3 $$E_t(ZGP) = \left(i(n)_a - i(n)_l\right)_t ,$$

the difference between the n-period asset $(i(n)_a)$ rate and the n-period liability $i(n)_l$ rate. Notice the loan (asset) and the n-period CD (liability) rates are known when the S&L makes the investment; therefore, the zero gap portfolio has no risk as measured by the standard deviation. Each period the portfolio net interest income equals the known differential between the rates and the net income is certain over the life of the loan. The zero gap strategy eliminates interest rate risk from maturity intermediation by eliminating maturity intermediation.

The return on the portfolio therefore must be a payment for services other than maturity intermediation. Using the expectations theory of the term structure (equation 1.5) to define the liquidity premium on the liability gives

2.4 $$i_1(n) = \frac{1}{n}\sum_{j=0}^{n-1} E_t i_{t+j} + \ell(n)$$

equal n-period asset and liability rates, and an expected profit of zero. In principle, the liquidity premium is a payment for taking a position between borrowers' and lenders' maturity preferences. With the zero gap portfolio the S&L simply acts as a broker who matches borrowers and lenders. As a broker the S&L finds a private agent who is willing to lend long for the premium. The S&L may receive a brokerage fee (a loan fee or points) but no premium for maturity intermediation. The S&L also may earn a return for other services it provides, e.g., the default risk of the loan may exceed the default risk for the CD; thus the loan rate might exceed the CD rate. We will ignore the expected return and risk from other aspects of the portfolio since the S&L will earn those returns and bear that risk whatever maturity structure it picks.[1]

The S&L can diversify the interest rate risk by choosing a linear combination of the risky and riskless loan portfolios,

2.5 $$C(LP,ZGP) = aLP+(1-a)ZGP.$$

The risk-expected return frontier for the combined portfolio in equation 2.5 is linear. The zero gap portfolio is riskless, so the risk of the combined portfolio is proportional to the fraction (a) invested in the risky portfolio,

[1]Technically the problem can only be separated if the probability of defaults is independent of the interest rate. In general one would expect a positive correlation between interest rates and defaults which provides another argument for fixed rate loans.

2.6 $$R[C(LP,ZGP)] = aR(LP),$$

and the expected profit is also proportional to the fraction invested in the risky portfolio,

2.7 $$E[C(LP,ZGP)] = aELP.$$

Thus as S&Ls move to safer portfolios by maturity matching they also move toward lower expected returns.

Variable Rate Loans

Variable rate loans are another popular strategy to reduce interest rate risk. Variable rate loans tie the loan rate to the liability (or some other short term) rate via a fixed formula. For simplicity, let

2.8 $$i_{a_t} = c_0 + i_{1_t}$$

the asset rate be a constant (c) markup over the liability rate. The expected profit for the variable rate loan portfolio is

2.9 $$E(VRP) = c_0,$$

the constant markup. The interest rate risk (standard deviation) of a variable rate loan portfolio is zero. In this case the borrower bears the interest rate risk of maturity intermediation. For example, if the borrower uses the loan to finance a project that has a constant annual payout, then the borrower's portfolio has the interest rate risk the S&L avoided. Like the zero gap portfolio the S&L earns no return for maturity intermediation when the variable rate loan succeeds in shifting the interest rate risk to the borrower.

Futures Hedging

Variable rate loans and zero gap portfolios reduce the S&L's exposure to interest rate risk by reducing the fraction of assets with an uncovered effective maturity gap, but these strategies also reduce the expected profits. Futures hedging, on the other hand, leaves the maturity gap on the loan portfolio unchanged but adds a futures portfolio whose profits vary positively with the liability rate. Thus, when the liability rate increases, the S&L's earnings on the loan portfolio decline, but the earnings on the futures portfolio increase, providing a hedge against interest rate risk. The futures market can provide a conventional risk hedge through diversification without altering the S&L's function in maturity intermediation.

This portion presents the expected profit and risk from a futures portfolio (FP) and from a combined loan and futures portfolio. It shows that the futures portfolio can be used to reduce interest rate risk for the S&L while maintaining the expected rate of return.

Let ${}_{t}F(i(m))_{t+1}$ denote the current (period t) price of an interest rate futures contract (where i(m) indicates the particular interest rate) for delivery one period in the future. Using similar notation let $S(i(m))_{t+1}$ denote the price of the spot instrument. Then, the expected profit from buying a futures contract and taking delivery of the spot instrument when the contract expires is

2.10 $$E_t(FP_{t+1}) = E_t z_t\left(S(i(m))_{t+1} - {}_{t}F(i(m))_{t+1}\right)$$

where z is the number of contracts. We assume the current futures' price is an unbiased predictor of the future spot price, so that expected profits are zero.[2]

The risk (standard deviation) of a futures portfolio depends on unanticipated changes in the price of the spot instrument,

2.11
$$\begin{aligned} R(FP_{t+1}) &= \left[E_t(FP_{t+1} - E_t FP_{t+1})^2\right]^{1/2} \\ &= |z_t|\left[E_t\left(S(i(m))_{t+1} - E_t S(i(m))_{t+1}\right)^2\right]^{1/2}. \end{aligned}$$

which are a function of unanticipated changes in the interest rate. Suppose the approximation

2.12
$$\begin{aligned} S(i(m))_{t+1} &= E_t\left(S(i(m))_{t+1}\right) + \frac{\partial S}{\partial i(m)}\, di(m)_{t+1} \\ &\equiv E_t S(i(m))_{t+1} - s(m)\left[i(m)_{t+1} - E_t(i(m))_{t+1}\right] \end{aligned}$$

adequately represents the spot price as a linear function of the interest rate. Equation 2.12 says the spot price at $t+1$ (approximately)

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[2]A systematic risk premium could be included without substantially altering the results. However, it is not clear whether the premium is positive or negative or zero and arbitrage limits the size of the premium so we chose a zero premium.

equals the spot price expected in t minus a constant $(s(m))$ times the unanticipated change in the interest rate.[3]

Using the approximation 2.12 to evaluate the futures portfolio risk gives

$$2.13 \qquad R(FP_{t+1}) \cong |z_t s(m)| \, [E_t(i(m)_{t+1} - E_t(i(m)_{t+1}))^2]^{1/2}.$$

The risk on the one-period ahead futures portfolio is proportional to the standard deviation of the one-period ahead interest rate forecast error. Notice the risk on the futures portfolio for $t+1$ is very similar to the risk for net interest income on the loan portfolio in $t+1$,

$$2.14 \qquad \begin{aligned} R(NII_{t+1}) &= \left[E_t\left[\left(i(n)-i_{t+1}\right) - E_t\left(i(n)-i_{t+1}\right)\right]^2\right]^{1/2} \\ &= \left[E_t(i_{t+1} - E_t i_{t+1})^2\right]^{1/2} \end{aligned},$$

which is also proportional to the standard deviation of the one-period ahead forecast error.

The formulas show the source of profit risk in both portfolios is interest rate risk. Diversification suggests a combined portfolio in which unanticipated losses in one portfolio are offset by unanticipated gains in the other portfolio. In fact an obvious perfect hedge exists

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[3]The partial derivative, $s(m)$, measures the sensitivity of the asset price to a change in the interest rate. Duration uses an elasticity measure of the sensitivity which is similar to $s(m)$ but expresses the sensitivity as a percent.

for one-period ahead earnings. The S&L can sell CD futures contracts and deliver them locking in its liability costs. In practice perfect hedges only exist for trivial cases; nevertheless, we can use the trivial case to illustrate the basic principle.

Let i denote the one-period liability (CD) rate. Then, the combined income (CI) for period t+1 from the loan portfolio and futures position is

2.15
$$\begin{aligned} CI_{t+1} &= NII_{t+1} - z_t\left(S(i)_{t+1} - {}_tF(i)_{t+1}\right) \\ &= i(n) - i_{t+1} + z_t s(1)(i_{t+1} - E_t i_{t+1}). \end{aligned}$$

Clearly, by choosing the appropriate number of futures contracts to sell (-z) the S&L locks in the net interest income. In this case, the hedge is perfect because the profit on the two portfolios is perfectly negatively correlated. Any unexpected loss of income from the loan portfolio is exactly compensated by an unexpected gain on the futures portfolio

2.16 $$CI_{t+1} - E_t CI_{t+1} = -(i_{t+1} - E_t i_{t+1}) + z_t s(1)(i_{t+1} - E_t i_{t+1}) = 0$$

when $z_t s(1) = 1$.

In general S&Ls cannot hedge their fixed rate loan portfolio earnings perfectly, but the ability to sell futures contracts offers an investment whose earnings are negatively correlated with the earnings on the loan portfolio. The S&L can expect to earn profits for the maturity intermediation service it provides in its local market, and hedge some of the interest rate risk in a national market in risk sharing.

Of course, practical hedging strategies are much more complicated. Liability rates, other rates, and futures prices are not perfectly correlated. In addition, futures markets only extend a few periods into the future and they have quarterly settlement dates. Therefore, a practical hedging strategy requires a sequence of futures positions where the risks are not perfectly matched.

Section 3: EMPIRICAL EVALUATION

The analytic results in sections 1 and 2 show that a futures portfolio provides a more efficient hedge against the interest rate risk inherent in maturity intermediation than a variable rate loan or zero-gap portfolio. The profits from the futures portfolio are negatively correlated with the profits from a fixed rate loan portfolio. As a result (in principle) the futures market can be used to reduce risk while maintaining the same expected rate of return.

In practice, the value of futures hedging depends on whether or not the correlation between the relevant interest rates, and between the interest rates and futures prices is large enough and stable enough over time to exploit. It also depends on whether a sequential strategy will provide sufficient protection, and whether a relatively small (as a fraction of assets) futures position will provide protection. Regulators and shareholders would not allow S&Ls to take large futures positions.

We conducted two empirical experiments to answer these questions. We calculated the sample correlation between monthly changes in various interest rates. The rates are not perfectly correlated but they are highly correlated. We also calculated earnings on a hypothetical S&L portfolio over the volatile and disastrous six-year period from 1977-1982 for simulated hedging strategies. During the period, short-term rates climbed inexorably from 5 percent to almost 20 percent; mortgage rates also rose, but more slowly. The average cost of funds rose quickly as S&Ls rolled over their short-term liabilities; revenue grew much more slowly as low interest rate, long-maturity mortgages held average revenues down. The unhedged simulations show the S&L suffers a major loss over the period (the S&L industry did experience major losses in 1981 and 1982). A conservative futures hedging strategy cuts the losses by almost 70 percent.

Correlations

Table 1 shows the correlation between the 90-day CD rate and other interest rates for the sample period. Except for the national average new mortgage rate, all the data come from Data Resources Inc. (DRI) financial data base. The national average new mortgage rate comes from the Federal Home Loan Bank Board (FHLBB). The data are monthly.[1]

The first column shows the correlation between the level of the various rates and the CD rate which we take as the most important determinant of the cost of funds. The second column shows the correlation between monthly changes in the rates and monthly changes in the CD rate. As one would expect, short maturity rates--the 90-day T-bill and the T-bill futures--are more highly correlated with the 90-day CD rate than the longer maturity rates.[2] Nevertheless, all the rates including the futures rates tend to be strongly correlated, indicating hedging is possible.

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[1]The data are based on lunar (28-day) months starting with the first month of 1977 and ending with the 8th month of 1982. The DRI data are a weekly frequency aggregated to lunar months and the FHLBB mortgage series is interpolated from calendar to lunar months. We wanted to use weekly data, but no reliable weekly mortgage rate series exists; lunar months are an unhappy compromise.

[2]The futures data come from the nearby futures contracts which average three months away.

Table 1

Correlations Between the 90-Day CD Rate and X

X	Levels	Changes
90-Day T-Bill	.994	.961
T-Bill Futures	.985	.882
20-Year T-Bond	.869	.668
T-Bond Futures	.809	.637
National Average New Mortgage	.866	.688
GNMA Futures	.863	.683

Simulations

To evaluate how well an actual hedging strategy might have worked over the period, we chose a hypothetical S&L portfolio and calculated the portfolio earnings based on various investment strategies using the historical rates to compute earnings. Table 2 gives an aggregated hypothetical S&L portfolio beginning in 1977.

Table 2 shows that the S&L has 60 percent of its assets in old (issued 10 or more years ago) and medium (issued in the past 10 years) mortgages. These fixed rate mortgages have interest rates of 4.5 percent and 6.5 percent respectively. This portfolio is more skewed toward low-earning fixed rate mortgages than the average S&L's (see Balderson) so the simulations paint a relatively pessimistic picture. The liability side of the balance sheet is closer to the average; 20 percent of the

Table 2

Hypothetical S&L Portfolio 1977

Assets		Liabilities	
Old Mortgages	20.	Passbook	20.
Medium Mortgages	40.	All-Savers' Certificates	23.
New Mortgages	20.	CD	52.
T-Bills	10.	Reserves	5.
Old T-Bonds	5.		
New T-Bonds	5.		

liabilities are low-cost core deposits, while 75 percent pay market rates.[3]

All the simulations keep the composition of the S&L assets and liabilities shown in table 2 fixed but let the maturity structure evolve. The book values of assets (liabilities) that mature, or are prepaid, in the month are reinvested (reissued) in the same asset (liability). In this passive strategy all changes in earnings on the basic portfolio accrue from interest rate changes. No gains (or losses) are due to active management decisions on the basic portfolio.

[3]Recently, financial deregulation and competition have lowered the fraction of core deposits, and soon virtually all deposits will pay a market rate.

In each month 1 percent of the old mortgages and 1/4 of one percent of the medium term mortgages are paid off. The book value of the outstanding mortgage principal is reinvested in new mortgages. 1/2 of one percent of the old T-bonds mature each month and are replaced with newly issued T-bonds. The liabilities also get repriced. All of the CDs get repriced at the current CD rate and 1/6 of the all-savers get repriced at the current T-bill rate each month. With no futures hedging the evolution of the initial $100 portfolio in table 2 gives a cumulative loss of $6.81 over the six-year period. The first four columns in table 3 give the results in more detail.

The difference between average gross earnings (column 2) and average cost (column 3) shows up in the sorry earnings (column 1) from maturity intermediation over this period. The earnings on existing mortgages did not keep up with the current liability costs. All interest rates increased, but in 1977 long maturity rates seriously underpredicted future short rates. As rates increased, the market value of low-yielding assets fell and the market value of S&L portfolios that contained old mortgages fell below book value (column 4). Column 4 reports the "market value" of the S&L calculated by discounting the income stream from assets with current asset rates to obtain the present value and subtracting the discounted present value of liabilitiy stream. Notice the "market valuation" is negative throughout the period.

Columns 5 and 6 show the net earnings from very conservative futures hedging strategies. The T-bill hedge represents a hedge similar to the liability rate hedge illustrated in section 2. T-bill and CD

Table 3

Simulated Results of Hedging Strategies

Year	No Hedging				T-Bill Hedge	T-Bond Hedge
	Net Earnings	Gross Average Earning	Average Cost	Market Value of S&L	Net Earnings	Net Earnings
77	1.85	6.45	5.09	-4.85	1.86	1.85
78	1.20	6.79	6.48	-9.88	1.23	1.55
79	- .56	7.29	8.78	-18.27	- .48	.51
80	-2.45	7.79	10.73	-21.39	-2.39	-1.19
81	-3.27	8.64	12.78	-29.04	-3.24	-1.48
82	-3.58	8.93	12.57	-22.83	-3.63	-3.36
Total	-6.81				-6.64	-2.12

rates are highly correlated and the T-bill futures market opened before the CD futures market and is thicker, so hedging in the T-bill market is similar to hedging in the CD market. The major difference from the theoretical perfect hedge in section 2 is that the hedge simulated in this section is a sequential hedge. Each period the S&L sells nearby futures contracts that have (a normalized) value of 3.33. Three months later the S&L closes out the position.[4]

Selling a T-bill futures contract provides a good hedge against unanticipated changes in liability rates in the near future. But sequential hedging in T-bills did not provide a good hedge against the unanticipated secular rise in rates. The T-bill hedge increases the gain or reduces the loss slightly in each year, but overall the hedge had no significant effect on earnings. The reason is intuitive: losses occurred because long rates underestimated the rise in future short-term rates, i.e., the six-year interest rate in 1977 was not the average of the one-year rates over the next six years. To directly hedge the liability rate risk in maturity intermediation the S&L needs to hedge against unanticipated increases in liability rates for a longer horizon than the futures market extends.

As an alternative to trying to directly hedge the liability rates we chose a hedge with long maturity instrument. The sixth column reports

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[4]In any month the book value of outstanding futures contracts is not greater than the S&Ls' T-bill holdings. The hedge is a covered position.

the results from a conservative T-bond hedge. If the market believes short rates have permanently increased, long rates should rise and the price of existing long-term bonds will fall until they yield the current rate of return. Therefore, a sequential T-bond strategy implicitly provides a hedge over a longer horizon. The simulated T-bond hedge is the same as the T-bill hedge except the S&L sells T-bond futures each month instead of T-bill futures. This hedge works considerably better. The S&L still takes a loss over this 5 1/2 year period but the unhedged loss is cut by 70 percent. The results are quite good considering the conservative hedge. Only 10 percent of the assets are hedged and 60 percent of the assets are low-yielding old mortgages. The market value of the S&L's portfolio declines by 23 percent over this period, yet the conservative hedge cut the loss in earning dramatically. A slightly less conservative rule that keeps short futures position less than 15 percent of assets cut the loss to -$1.79 over this period.

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