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Hedging Interest Rate Risk With Financial Futures

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HEDGING INTEREST RATE RISK
WITH
FINANCIAL FUTURES

By

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APPROVAL

This independent study submitted by Jerry M. Stai in partial fulfillment of the requirements for the Degree of Master of Business Administration from the University of North Dakota is hereby approved by the Faculty Advisor under whom the work has been done. This independent study meets the standards for appearance and conforms to the style and format requirements of the Graduate School of the University of North Dakota.

Dr. Orville Goulet
Faculty Advisor

PERMISSION

Title: HEDGING INTEREST RATE RISK WITH FINANCIAL FUTURES

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Degree: Master of Business Administration

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Date May 1986

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ABSTRACT

In the period of volatile interest rates since 1979, many businesses have sought to lower their exposure to interest-rate risk, which is the probability that profits and values will be adversely affected by changes in market interest rates. The thrift industry has particularly been damaged by interest-rate risk. By borrowing short-term and lending long-term, liabilities repriced or matured faster than assets, which cause a classical earnings squeeze. The Federal Home Loan Bank, the regulatory agency for the thrifts, has set into law regulations authorizing individual thrifts to utilize financial futures as a tool to reduce interest-rate risk. The central issue of this paper is that interest-rate risk needs to be managed. One thing certain about interest rates is that they either go up or down. Hedging with financial transfers that risk to someone else.

INTRODUCTION

A. BACKGROUND INFORMATION

In the period of volatile interest rates since October of 1979, many businesses have sought to lower their exposure to interest rate risk, which is the probability that profits and values will be adversely affected by changes in market interest rates. Virtually all businesses that must finance in the short-term interest markets have some exposure to interest rate risk. This risk can make good investments unprofitable, distort balance sheets, and generally confound the planning process. The uncertainty of future interest rate levels makes accurate financial planning difficult and can lead to undesired earnings volatility unless interest rates on assets adjust with those of liabilities.

The thrift industry has particularly been damaged by interest rate risk as can be seen in Exhibit A. Although thrift institutions have enjoyed growth in assets over the last two decades and have been able to increase absolute dollars of net worth, their collective networth-to-assets ratio declined steadily from 7.04% in 1970 to 3.71% in 1982. Over the same period, rate-sensitive assets, which reprice or mature within six months, increased modestly relative to rate-sensitive liabilities and Exhibit B illustrates this relationship. The most notable change in this asset-liability relationship was in 1980, three years after thrifts started offering 6-months certificates of deposit, which followed closely to the 6-month Treasury bill. As the level of interest rates rose in the early 1980's the GAP, defined as rate-sensitive assets minus rate-sensitive liabilities, increased dramatically meaning liabilities repriced or matured

EXHIBIT A

Interest Rate Sensitive Assets Versus Liabilities
and the Effect on Net-Interest Margin

	1960	1970	1975	1980	1981	1982	1983
Total Assets year-end (billions)	$ 71.5	$176.2	$338.2	$629.8	$664.2	$706.0	$762.5
Net worth year-end (billions)	$ 5.0	$ 12.4	$ 19.8	$ 33.4	$ 28.4	$ 26.4	$ 29.1
Net Worth/Assets year-end	6.97%	7.04%	5.85%	5.30%	4.28%	3.71%	3.82%
Rate Sensitive Assets[1]/ Total Assets	8.4 %	8.7 %	9.3 %	11.4 %	13.3 %	14.1 %	18.7 %
Rate Sensitive Liabilities[2]/ Total Assets	9.1 %	13.9 %	17.7 %	38.1 %	45.2 %	49.2 %	56.0 %
GAP[3]/Total Assets	‹0.7 %›	‹5.2 %›	‹8.4 %›	‹26.7 %›	‹31.5 %›	‹35.1 %›	‹37.3 %›
Net Interest Margin[4]	1.57%	1.42%	1.37%	0.91 %	0.29%	0.63 %	0.50%

Source: Federal Home Loan Bank Board, Combined Financial Statements, FSLIC - Insured Institutions, selected years.

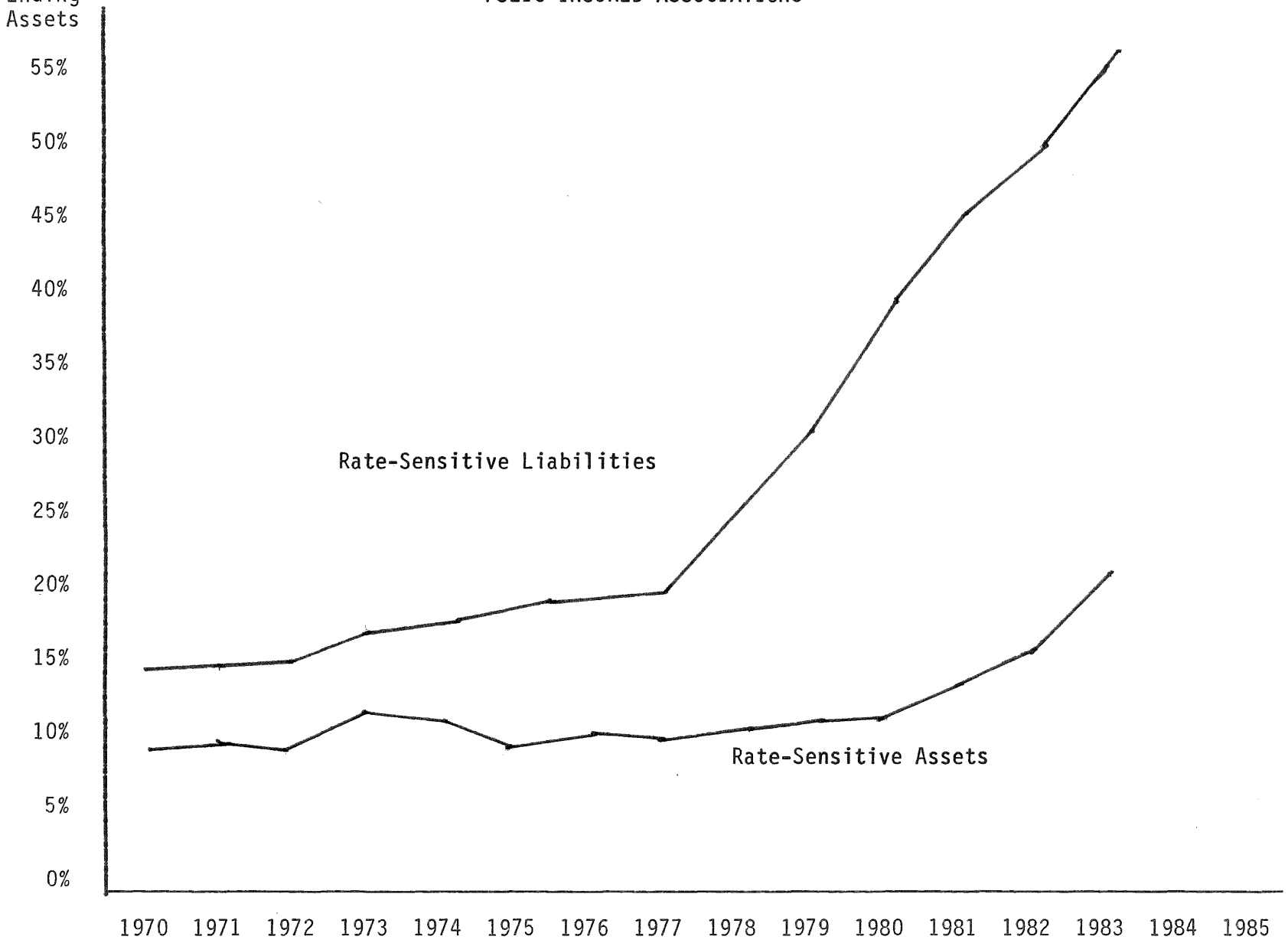
1. Rate Sensitive Assets are assets that reprice or mature within six months.

2. Rate Sensitive Liabilities are liabilities that reprice or mature within six months.

3. GAP is the difference between rate sensitive assets and rate sensitive liabilities.

4. Net Interest Margin is the remainder of interest income minus interest expense divided by average total net assets.

RATE-SENSITIVITY TRENDS
FSLIC-INSURED ASSOCIATIONS



Rate-Sensitive Assets and Liabilities are those assets and liabilities that will either mature or be repriced within six months.

faster than the assets. In an increasing interest-rate environment, liability costs rose faster that assets earned. This can be reflected in the net interest margin, which is the remainder of interest income minus interest expense divided by the average total net assets. As shown in Exhibit A the net interest margin in 1960 was 1.57% and steadily deteriorated to 0.63% in 1982 causing the net worth ratio to decline.

The degree of interest-rate risk in thrifts has increased substantially during the last decade because of greater fluctuations in market interest rates and the large shift to interest sensitive liabilities. Regulatory authorization for hedging and futures operations as well as more rate-sensitive types of assets has provided tools for more effective management of interest-rate risk.

Hedging

Hedging refers to any action taken to reduce an existing risk. Traditional hedging theory emphasizes the risk avoidance potential of futures markets.[1] Whereas the cash market is the market in which an actual physical commodity is traded, a forward market transaction is merely a cash transaction in which two parties agree to the purchase and sale of a commodity at some time in the future under such terms as the two parties state. The future market is distinguished from the forward market in that the futures contract is a standardized agreement obligating two parties to a transaction involving a set amount and grade of a commodity at a price and time specified. Hence, hedgers take futures positions equal and opposite of their position in the cash market so the price change in one market offsets the price charge in the other.

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[1] Mark J. Powers, Inside the Financial Futures Markets, 2d Ed. (New York: John Wiley and Sons, Inc., 1984) p. 175.

Hedging cannot take place in the absence of active speculative interest, and speculation cannot take place in the absence of price volatility that generates a need for active hedging operations. A hedger enters the futures market to offset or manage an existing risk by shifting that risk of price change to a speculator. The speculator in the futures market invests for the prospect of gain rather than to offset a risk position.[2]

Once financial futures have been chosen as a tool, the hedger must identify whether his application requires going long or short contracts. In going long, an investor purchases the obligation to take delivery of a financial instrument at a set price at a future date. In going short, an obligation is established to make delivery in the same manner. The effect of going long is much like lengthening the maturity of a portfolio to benefit from a rise in market price. Conversely, going short is similar to shortening maturity or selling assets held in a portfolio to benefit from a decline in market price.

Because financial futures have neither a yield nor a unique credit risk, the main feature captured by the contracts is the volatility of the instrument on which the contracts are written. For this reason, financial futures can be used effectively as a principal management tool to offset general market volatility.

B. RESEARCH OBJECTIVE

As a group, thrift institutions generally rely on savings deposits as a main source of borrowed money. Their assets tend to be longer term investments

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[2] Oliver H. Jones, Financial Futures Market, (U.S. League of Savings Institution, 1983), pp. 22-23.

in mortgages with a relatively small highly liquid portfolio of short-term investments. This type of asset and liability mismatch, short-term borrowing and long-term investment, is a classical formula for failure. As short term rates rise, the profit spread between assets and liabilities narrows and eventually becomes negative, due to increasing costs of a rising interest rate market. Since interest rates are intrinsic to the thrifts business activities they must be actively evaluated and managed to reduce undesired speculation. Understanding the existing risks associated with rate volatility and then doing nothing about them is speculation by inertia which could be recognized as a costly way of doing business. Therefore, in March of 1982 the Federal Home Loan Bank System, the regulatory agency for thrifts, developed a futures policy for the primary purpose to provide a number of flexible, efficient tools to reduce the interest-rate risk of individual thrifts and the banking system as a whole.

The objective of this research is to determine how thrifts can use financial futures to reduce interest-rate risk in its asset and liability management. Because thrifts in recent years have become more involved in selling their mortgage loan production, there exists an interest-rate risk between the time a loan is originated and sold. A sub-objective of this research is to determine how thrifts can use financial futures to reduce interest-rate risk in originating and selling mortgage loans.

C. RESEARCH METHODOLOGY

Constraints

Given the interest-rate risk apparent to the thrift industry, there are other solutions including internal hedges, forward cash markets, and shorter-term investments. None of these alternatives remove the essential need for mastering the process of hedging in financial futures. This paper will be

limited to the financial futures as a hedging tool for the thrift industry against interest-rate risk. The research will be constrained to the currently published literature.

Methodology

The methodology used in conducting this study will consist of a complete review of the available literature. In addition, personal interviews will be conducted with investment bankers and other practitioners of financial futures operations.

Organization of the Study

In order to use financial futures to reduce interest-rate risk, Chapter II entitled "The Concept of Hedging" will introduce, explain, and illustrate concepts of hedging using financial futures. Chapter III consists of "Market Instruments Used In Hedging", describing the various contracts used in the hedging process. Chapter IV will combine the knowledge of hedging and the market instruments in "Designing the Hedge Strategies for Thrifts". Chapter V will summarize and conclude this paper.

CHAPTER II

THE CONCEPT OF HEDGING

Hedging in the futures market can be defined as the use of futures contracts as an economic (price) substitute for a transaction that will be made at a later time in the cash market.[3] The objective of an interest rate hedging program is to offset changes in the value of assets or liabilities with corresponding profit or loss from futures transactions.[4] By hedging in interest rate futures, one can establish in advance a specific rate of interest rate volatility.

Hedging should be looked upon as a process of risk management that involves decisions as to whether, when, and how to utilize the futures markets. The following can aid in this process:[5]

1. What is the risk exposure?

   This step is to quantify the loss that would be incurred if there were no hedge. The answer includes analysis of the outlook for interest rates, the estimation of the size of the rate change and the probability of its occurrence. Once this has been identified, the outcome can be calculated.

2. Is the risk affordable?

   If the size of the risk is small relative to the capital of the company, no hedge may be necessary. However, if the risk is large relative to the capital, then the hedge should be implemented.

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[3] Nancy H. Rothstein, ed., The Handbook of Financial Futures, (New York: McGraw-Hill, 1984), p. 157.

[4] Ibid.

[5] Mark J. Powers, Inside the Financial Futures Markets, 2nd ed. (New York: John Wiley & Sons, Inc., 1984), pp. 182-184.

3. Is the risk hedgeable in the futures market?

   The answer to this question is found through analysis of the correlation of price movements in the cash instrument and the futures contract. One must make sure to hedge price movements and not interest rate movements. For example, the value of .01 change in the rate for 90-day T-bill futures is $25. The value of .01 change in the rate for a six-month T-bill is $50. Therefore, if one was using T-bill futures to hedge risk of a six-month CD, one should use twice the dollar amount in the futures markets to reflect the risk associated with the cash market position.

4. What is the basis relationship?

   Basis is the single most important concept in hedging. Basis is defined as the difference between the price of the futures contract and the price of the instrument held in a cash position. All successful hedgers know and understand their basis and how and why it changes. A regression analysis can be used to measure the size of the basis relationship and give the sense of the probability of its changes.

5. What are the costs of hedging?

   There are two main costs. Execution costs are reflected in the difference between the bid and the ask prices in the market. For example, if one were to buy a contract and resold it immediately, he would give us a spread between the bid and the ask. The second area is the transaction costs including the commissions paid to the broker and the opportunity cost of interest lost on money posted as margins.

6. What are the implications of the hedge?

   Generally all money made or lost on hedges are considered income. But, because of the complexity of the IRS code, it is important that an accountant provide an opinion.

A. CONCEPT OF BASIS

Most descriptions of hedging start with a hypothetical "perfect hedge" such as the following:[6]

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[6] Frank J. Fabozzi and Irving M. Pollack, ed., The Handbook of Fixed Income Securities, (Homewood, Illinois: Dow Jones - Irwin, 1983), pp. 835-836.

June 1:	
Owns $1 million U.S. Treasury 7 7/8 of 1995 at 68-04 to 12.329 percent.	Sellers 10 December bond contracts at 69-02 to yield 12.152 percent.
No transaction.	
December 1:	
U.S. Treasury 7 7/8s of 1995 are at 60-12 to yield 13.870 percent.	Buys 10 December bond contracts at 61-10 to yield 13.705 percent.
No transaction.	
Unrealized loss: 7 24/32 or $77,500	Realized profit (before commissions): 7 24/32 or $77,500

In a rising interest rate environment, shorting futures against an inventory of financial assets hedges the inventory against the loss of value that would result as interest rates rise (prices fall). A short futures position would yield a profit as rates rise. The erosion in the value of the cash market asset would be hedged to the extent of the profit made on the futures.

In the above example, the futures and the cash prices declined by identical amounts between June 1 and December 1, so that the $77,500 paper loss incurred in the bond portfolio was perfectly offset by an equivalent profit on the short futures position. Another way to look at it is that the hedge was initiated on June 1 at a 30/32 difference (69-02 minus 68-04) and was unwound on December 1 again at 30/32. This difference between cash and futures prices, called the basis, is the controlling factor in determining the outcome of all hedge positions.

If the basis on December 1 was less than 30/32, signifying that the futures price had declined less than the cash market, the futures gain on the short position would not have matched the decline in the market value of the cash position. If, on the other hand, the basis on December 1 was greater than 30/32, the futures gain would have exceeded the cash market loss. In either

case the hedge would have gone beyond the textbook example to the real world of a changing basis. The overriding question becomes: Did the basis grow wider or narrower over the period hedged and by how much?

Perfect hedges rarely occur which causes basis risk. Holbrook Working, an economist, challenged the view of hedgers as pure risk minimizers and instead emphasized expected profit maximization.[7] He thought hedgers functioned like speculators in that hedgers were concerned about relative, not absolute, price changes. Hedgers, in effect, speculate on the basis. Therefore, basis risk is a trade-off to interest rate risk. Basis risk can be thought of as the hedger's risk.

In managing the basis risk the question is how and when should the hedge be adjusted for basis changes? There are two basic approaches.[8] The "portfolio approach" uses the futures contracts to coincide with the time of unwinding the hedge. This is considered passive. The other approach is the "price relationship approach" whereby hedger continuously evaluates the price structure to take advantage of opportune movements in the cash and futures prices. In this method, the hedger should understand the cause of basis changes and monitor them closely through technical and fundamental analysis.

Cross Hedging

If every cash market instrument had a futures contract, there would be very good hedges. Sincere there is not a futures contract for every cash instrument,

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[7] Mark J. Powers, Inside the Financial Futures Markets, 2d ed. (New York: John Wiley & Sons, Inc. 1984), p. 180.

[8] Nancy H. Rothstein, ed., The Handbook of Financial Futures (New York: McGraw-Hill, 1984). pp. 161-177.

hedgers may have to use a futures contract different for that of the cash position but similar in price changes. This is called a cross hedge. An example of a cross hedge is the use of T-bill futures to hedge a cash market instrument such as commercial paper. The reason for using cross hedges is that the cost of additional basis risk is weighed against the cost of not being hedged at all. The futures contract for the hedge is selected after a correlation analysis identifies the extent in which the cash instrument prices change with it.[9]

B. STRUCTURING THE HEDGE

The purpose of a hedge transaction is to earn from the futures position an amount of money equal to the change in value of the interest rate exposure being hedged. Because of maturity, coupon, credit worthiness and other differences between the cash instrument and the futures contract, there usually is no dollar for dollar change in values as interest rate changes. Therefore, a hedger must use dollar equivalency,[10] which refers to the process of structuring the hedge in such a way that the hedger obtains equivalent dollar changes in the cash and futures positions for the same interest rate change. Once this analysis is complete, it will determine the hedge ratio, the number of futures contracts required to offset the equivalence in the cash market.

Maturity Adjustments

The maturities of the debt instruments in the cash and futures positions will usually be different. This needs to be compensated. For example, assume a $1,000,000 floating rate loan for one year, with the rate tied to the prime rate. This loan could best be hedged by using 90-day CD or Euro dollars

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[9] Mark J. Powers, Inside the Financial Futures Markets, 2d ed. (New York: John Wiley & Sons Inc., 1984) pp. 185-191.

[10] Ibid.

futures. If one were to use dollar-for-dollar hedging, that is a $1,000,000 90-day CD futures contract to hedge the $1,000,000 loan, one would find that each basis point move in the loan would result in a $100 change in principal value. Therefore, one would use a 4 to 1 ratio by using $4,000,000 in futures value to hedge $1,000,000 in a cash position. However, as time passes and the one-year loan becomes a 270-day loan, a one point change in the yield rate on the loan would be equal to only $75 in principal value, while one point change in the CD contract would still be equal to $25. Thus, one would use a 3 to 1 hedge ratio.[11]

Sensitivity Analysis

Interest rates for different instruments usually change at different rates. To compensate the hedger should calculate the sensitivity through regression analysis using historical data. This sensitivity factor is known as the beta coefficient. For example, from January 7, 1977 to March 1, 1978, the regression equation relating the prime rate to T-bill futures rates was:[12]

.97 X T-bill futures rate

In this case the beta coefficient was .97, which meant that when the T-bill futures rate moved 1 percent, the prime rate would move .97 percent. The 1.46 percent represents a statistical spread between the prime rate and T-bill futures in the regression equation. It is usually not important in evaluating the number of contracts to use. The data was rerun from the period of January 7, 1977 to May 2, 1980, and the beta coefficient was 1.39. Obviously, this shows that the relationship between the prime rate and T-bill futures has changed. To summarize, if the hedger were to hedge a 1-year prime rate loan, the correct method for calculating the futures position would be:

Exposure (in millions) X maturity X sensitivity = no. of contracts
adjustment (beta) factor

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11 Ibid.

12 Nancy H. Rothstein, ed., The Handbook of Financial Futures, (New York: McGraw-Hill, 1984) p. 162.

Conversion

The conversion factor equates the coupon of the instrument being hedged with the futures contract coupon.[13] In these cases, hedgers should weight their hedges, using a greater or lesser number of contracts than the face value of the cash item being hedged in order to achieve the same dollar value in the two coupons for the same rate change. For example, a 10-year Treasury future contract with an 8% coupon needs to be weighted if the cash item is something other than an 8%, 10-year instrument. This is so because a small increase in interest rates for an 8% coupon might lose only $100 of value, while a 13% coupon would lose $130 of value. Therefore, a hedge hedger would use 1.3 times as many futures contracts as the amount being hedged.

Selecting the Contract Month

As in basis management there are two approaches in selecting the contract months of the futures instruments in a hedge position. With the "portfolio approach" the hedger will unlikely change the contract month of his hedge because he selects the contract month to coincide as close as possible with the maturity month of his cash position. In contrast the "price relationship approach" involves continuous evaluation of delivery month price relationships. Here a hedger would take advantage of unusual price relationships to place, manage or lift his hedge positions. The hedger generally does not want to hold positions during a contract's delivery month because of the unusual basis moves during the delivery month. Another concern is the liquidity for the contract month, which is reflected in the total volume being traded for that contract.

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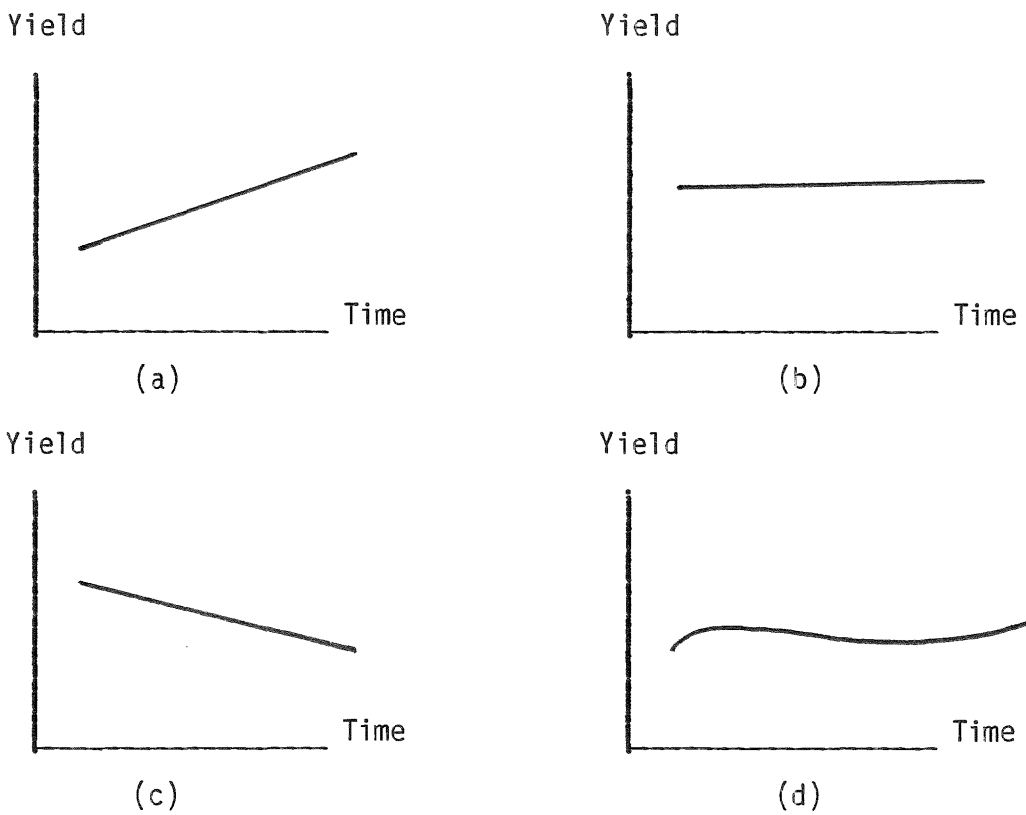
[13] Ibid. pp. 174-175.

To understand the effects of one contract month over another contract month in a "price relationship approach" the hedger needs to be aware of shifts in the yield curve, changes in financing costs, and convergence.

A yield curve is a chart in which yields are plotted on the vertical axis and the term to maturity of U.S. government debt instruments is plotted on the horizontal axis.[14] A normal yield curve as shown in (a) below is an upward curve to the right, reflecting the investor's demands for higher yields for longer term investments. In (b) below, the yield curve is flat showing rates a fairly even across the maturity range. An inverted yield curve as shown in (c) below exists when short-term rates are higher than long-term rates and sometimes yield curves become humped as shown in (d).



An informed judgment regarding the basis begins with the study of the cash-futures price structure. Just as you can develop a yield curve for the cash

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[14] Ibid. p. 607.

market, you can develop a yield curve for the futures market. The process of constructing the futures yield curve is similar to that for constructing the cash market yield curve. The major difference is that one used data from the different futures contracts; that is, the 90-day Treasury-bill contract, the 10-year Treasury note and the Treasury-bond contract.

The pattern of successive delivery-month prices is generally one of increasingly greater discounts from, or premiums over, the price/yield, which depends upon the absolute trend of interest rates and the relationship between short and long term rates. When the concensus of market participants is that interest rates will continue to rise (as illustrated by an upward-sloping yield curve), the contract price for each successive delivery month is lower than the preceding one. As the expectation increases that the cyclical peak in interest rates are near (as illustrated by a flattening or downward-sloping yield curve), prices of contracts will become progressively higher, reflecting the anticipation of lower yields as time passes. The progression from premium to discount to parity with price/yield is not always a smooth one, therefore causing changes in the basis.

In addition to the cash market yield curves and the future markets yield curve there is a third yield curve, the "strip" curve, which provides another benchmark for value. The strip is simply a series of successive Treasury-bill futures contracts. For example, if you purchase the December, March, June and September futures contracts, you would own a one-year strip. In actuality, ownership of that one-year strip is the same thing as owning a 12-month Treasury-bill, because the series of futures provides the rights to purchase a 90-day Treasury-bill every three months, and the total maturity span is 12 months.

"Cost of carry" refers to the net cost of owning a cash investment for a given period. For example, the cost of carry on a 90-day T-bill is the net interest differential between the interest earned on the 90-day cash investment and the cost of borrowing the initial money needed to pay for the 90-day T-bill. For example, if one could borrow 90-day money at 10% and buy 90-day T-bills at 12%, then the cost of carry is a positive 2%. If 90-day T-bills yielded 8%, then the cost of carry is a negative 2%. Normally, one would use repo rates as the cost of borrowing. Repos are sale and repurchase agreements whereby one sells an instrument and simultaneously agrees to repurchase the instrument at a later date at a specified price. The buyer, and later reseller, of the instrument in effect is making a loan because he pays for the instrument when purchased and receives the money back when the instrument is repurchased. The rate of interest is therefore implied in the price differential. Once one knows the cost of carry for a cash market investment, one can then determine whether the futures contracts are cheap relative to each other.

As a substitute for using the repo rate, one can use the cash yield curve. If it is normal, that is an upward sloping yield curve, the cost of carry is positive. If the yield curve is inverted, that is downward sloping yield curve, the cost of carry is negative.

The cost of carry is a convenient technique for estimating the value of a particular future relative to other futures and to the cash instrument. But the futures market frequently reacts to other forces, mainly the "expectations" of the market. If market participants expect cost of carry or absolute interest rates to change significantly, those considerations may be more important than the cost of carry considerations.

Since futures prices are a function of the cost of carry and expectations, the closer the date of maturity or contract expiration, the less the effect of the expectations. The closer the delivery date, the less the futures price will fluctuate from the spot price. In fact, the price of an expiring futures contract will equal the price of the deliverable cash market instrument at the close of trading on the contract expiration date. This is referred to as convergence.[15]

Contract Specifications

Once the futures contract has been selected, one should study the contract's specifications carefully to determine if there are any provisions that may make it trade differently from cash. There are two major areas of concern. First, does the contract have specifications for a "market-basket" delivery, whereby the deliverable item could be any instrument within a broad spectrum of maturities? Deliverable grade specifications should be examined to see what may be delivered if a position was held to expiration. Second, is the contract written to facilitate delivery? Some contracts will have severe aberrations from the cash market due to their contract delivery specifications. So, when possible, use a contract that does not present the added risk of delivery distortion.

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[15] Arthur J. Powers, Inside the Financial Futures Markets, 2d ed., (New York: John Wiley & Sons, Inc., 1984), pp. 128-144.

CHAPTER III

MARKET INSTRUMENTS USED IN HEDGING

A. TREASURY BILLS

The Treasury Bills are short-term U.S. government debt instruments with maturities of one year or less, which are sold by the Federal Reserve, with 3, 6, or 12 month maturities. The Federal Reserve auctions 90-day T-bills and 180-day T-bills weekly and 1-year T-bills monthly. Treasury-bills are traded at a discount so that the price paid is less than face value and the difference between the price paid and the face value equals the interest over the T-bill period. After the Treasury-bill futures market was established in 1976, it has grown to one of the largest futures markets. Hedgers in this market are those investors whose cost of money is pegged to short-term interest rates.

Futures contracts for T-bills are deliverable in March, June, September and December. The price of a futures contract is quoted in terms of an exchange-devised index representing the actual annualized T-bill yield subtracted from 100. For example, an index of 94.00 represents an annual yield of 6%. A rise in the index means a decline in yields. The minimum price change for T-bills is one basis point. A basis point is a .01%. A one basis point move in price for a 90-day T-bill contract is worth $25; for a 180-day T-bill, $50; for a 1-year T-bill, $100. Thus, if a 90-day T-bill price moved from 94.00 to 94.10, the value of that contract changed $250.

Treasury Bill Formulas

1. Calculating the actual dollar price from the quoted yield prices.[16]

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[16] Mark J. Powers, Inside the Financial Futures Markets, 2d ed. (New York: McGraw-Hill, 1984) pp. 519-520.

$$\$ \text{ price} = \$1{,}000{,}000 - \frac{(\text{days to maturity} \times \text{T-bill yield} \times \$1{,}000{,}000)}{360}$$

2. Determining yield when T-bill face value, days to maturity, and actual issue price are known.

$$\frac{(\text{T-bill face value} - \text{actual issue price}) \times 360}{\frac{\text{days to maturity}}{\text{T-bill face value}}} = \text{T-bill yield}$$

for example, \$1,000,000 X 91 days:

$$\frac{(\$1{,}000{,}000 - \$984{,}833.33)}{\$1{,}000{,}000} \times \frac{360}{91}$$

3. Calculating equivalent bond yield. This is a much misunderstood number. It relates the yield on T-bills to the yields on coupon-bearing securities, taking into consideration the amount of the discount from face value and the time until maturity. T-bill yields are calculated on a 365-day basis.

$$\left(\frac{\text{T-bill face value} - \text{actual dollar price}}{\text{actual dollar price to maturity}}\right) \times \frac{365}{\text{actual days}}$$

For example, 6% yield, \$1,000,000 worth of T-bills, with 91 days to maturity:

$$\frac{(1{,}000{,}000 - 984{,}833.33)}{984{,}833.33} \times \frac{365}{91} = 6.18$$

This formula will cause a slight overstatement of T-bill yield versus coupon-bearing investments when comparisons are made of T-bills over 180 days to maturity, because the coupon instrument will have a coupon interest payment to reinvest after six months. Treasury bills make no six-month interest payments; they only pay 100% of face value at maturity.

B. TREASURY NOTES AND BONDS

Treasury notes are coupon-bearing securities issued by the U.S. Government with maturities of more than one year and less than ten years. Notes are sold in a variety of cycles. Two-year notes are issued each month with a two-year maturity. Four-year notes are issued in the last week of each quarter with a

four-year maturity. Eventually these notes will have two years remaining to maturity and thus become two-year notes. In January, April, July and October five-year and ten-year notes are issued. Treasury Bonds are issued in two different cycles: (1) each January and July 15-year bonds are auctioned; and (2) every quarterly refunding has bonds of 25 to 30 year maturities.

The Treasury-bond contract is the most actively traded of all futures. It trades on a basis of hypothetical bond issue created by the exchange: (1) setting a standard coupon rate at 8%; and (2) establishing a minimum maturity date whereby the remaining maturity is not less than 15 years. The futures are traded on a dollar price. The Chicago Board of Trade (CBT) uses a factor method of converting different coupons and maturity dates to equate with the 8% exchange standard. This ensures equal price of any deliverable bond. The hedger needs to weight a hedge to get the correct dollar value relationship between cash and futures markets.

For example, two different bonds both with a CBT price of $80,000 for the March 1980 contract:[17]

1. Issue 7 5/8 of 2/15/2002-07. Time from call date until delivery date of March 20, 1980 = 21 3/4 years.
2. Issued 10 3/8 of 1115/04-09. Time from call date until delivery date of March 20 = 20 3/4 years.

The factor for the 7 5/6 with 21 3/4 years is 0.9614.
The factor for the 10 3/8 with 24 3/4 years is 1.2540.
The factor is multiplied by the exchange price to get the correct principal value for each bond.

80 (exchange price for March 80 futures) X 0.9614 (factor) = 76.912 for 7 5/8 of 07.
80 X 1.2540 = 100.32 is the price for 10 3/8 of 2009.

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17 Ibid.

The total invoice price is found by multiplying the dollar price by the fact amount. ($100,000 X 7.9912 = $799,120.00) The accrued interest from the last coupon date is then added.

To illustrate how maturity affects the price of the cash bonds, assume the 7 5/8 of 2/14/02-07 were to be delivered into the June 1980 contract instead of the March. The factor would then be 0.9618. Assume the price of June CBT T-bond futures to be 80.00, the same as March futures in the above example:

80 X 0.9618 = 76.944

C. GNMA's

The Government National Mortgage Association (GNMA) is a division of the Department of Housing and Urban Development. GNMA takes pools of existing FHA (Federal Housing Administration) and VA (Veterans Administration) mortgages and issues a certificate that guarantees principal and interest from that pool will be paid to the certificate holder. When an investor purchases a GNMA certificate he receives a certificate showing an ownership share in a pool of mortgages. The certificate contains the description of the pool; the face value; the percentage of unpaid principal outstanding on the mortgages; the current principal balance; the coupon rates the holder receives; the pool number; and the date the pool was issued.

Payment of principal and interest are paid to the "owner of record" on a monthly basis. Any prepayments that occur by borrowers paying off the mortgage or by default are paid to the certificate holders on a pro rata basis. Although the GNMA certificate consists of 30-year mortgages, history has shown these mortgages prepay on an average of 12 years.

GNMA certificates with high coupons will have a tendency to pay off earlier as the level of interest rates decline; GNMA certificates with lower coupons will have a tendency to have a longer life as the level of interest rates rise.

The futures exchange has a GNMA futures contract called CDR or Collateralized Depository Receipt. The CDR is based on an 8% GNMA with a 30-year maturity prepaid in 12 years. The CDR is a document signed by a depository that attests that an originator has deposited ($100,000 minimum principal balance of GNMA 8's [8% coupon]). Coupons other than 8% coupons can be delivered but are adjusted to provide the equivalent yield. This means that if a seller were to deliver a GNMA coupon less than 8%, he would deliver more than $100,000 face value. If the coupon being delivered was higher than 8%, the seller would deliver less than $100,000.

CHAPTER IV

DESIGNING HEDGE STRATEGIES FOR THRIFTS

A. REGULATION AUTHORIZATION

On October 8, 1975, the Federal Home Loan Bank Board informed the thrift industry of its intention to set into law regulations on the use of financial futures. On May 21, 1976, the Bank Board adopted final regulations dealing with mortgage futures transactions. In May 1981, the regulations were revised to include trading in financial options and to eliminate several former limitations and restrictions. In its statement the Bank Board said the interest rate futures market provides an opportunity for users to hedge against the risks of unanticipated movements of interests rates, most notably by:[18]

1. Lowering the risk of forward commitments (e.g., to purchase mortgage-related securities or loan commitments to builders) by assuring offsetting compensation when the securities or loans are below market rate at a settlement. (In effect, a hedge transaction can assure that a fixed-rate forward commitment yields approximately a market rate of return upon settlement, even if the interest rates have risen in the interim);

2. Locking in sources of financing sensitive to market rates of interest (such as MMC's and SSC's) at known rates so as to decrease the risk involved in making long-term loans and forward commitments; and

3. Diminishing the adverse effects of decreasing asset yield/liability cost spreads resulting from increases in interest rates on liabilities relative to the yields on assets.

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18 Nancy R. Rothstein, ed. The Handbook of Financial Futures, (New York: McGraw-Hill, 1984) pp. 519-520.

Authorized Transactions

In amending the regulations in 1981 the Bank Board's intention is to allow institutions to engage in "futures transactions that reduce the net interest rate risk exposure arising from the institution's asset and liability structure." Allowable short futures positions included:[19]

1. To protect against the risk resulting from forward commitments to originate or purchase mortgages or mortgage-related securities.

2. To protect the value of mortgage loans or other investments held in portfolio.

3. To fix liability costs.

4. To protect against other risks resulting from a maturity imbalance between assets and liabilities.

With regard to long positions, the Bank Board believes that the risk inherent in the typical thrift institution's asset and liability structure will not be lessened, and most probably will be increased, by long positions in the futures market. It did recognize that these institutions with mortgage banking operations may use long positions when they have contracted to sell mortgages not yet originated. Therefore, the Bank Board does allow long futures positions to be taken in connection with forward commitments to sell mortgages not yet originated.

Authorized Contracts

The Bank Board's May 1981 regulation permitted the use of Treasury bills, notes, and bond futures contracts in addition to GNMA futures contracts. The final regulations now permit institutions to engage in interest rate futures transactions using any interest rate futures contract that is designated by the commodity futures trading commission and is based upon a security in which the institution is authorized to invest.

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19 Ibid. p. 522.

B. HEDGING ASSETS

To minimize the risk of increasing interest rates (decreasing value of a long-term mortgage loan), thrifts can hedge in the interest rate futures market. For example:[20]

> On January 5, 1981, a financial institution purchased $10 million in GNMA securities carrying a 13% coupon at 06-8 (96 and 8/32nds). Having watched GNMA prices drop 10 or more points a year earlier and having already absorbed a decline in price to 96-2 in less than two weeks, management decides to hedge the institution's position on January 12.

Cash Market	Futures Market
January 12	**January 12**
Holds $10,000,000 GNMA 13% certificates at 96-2 Market value $9,606,250.	Sells 100 GNMA-CDR March futures contracts at 70-14, or $7,043,750.
March 2	**March 2**
Cash market is 92-15 Market value $9,246,875.	Buys 100 GNMA-CDR March futures contracts at 65-20, or $6,562,500.
Loss: $359,375	Gain: $481,250
Net Gain on Hedge: $121,875	

This example was based upon actual prices. During the period the hedge was in place, the basis strengthened by 39/32nds and produced a net return in the hedge of $121,875. Of course, not every hedge turns out so well. In this case, had the hedger held his futures position until the March contract closed, he would have purchased the offsetting contract at 68-2 and found that the value of his GNMA holdings had declined to 94-8. The net result would have been a gain of $56,250. Convergence was at work.

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[20] Oliver H. Jones, Financial Futures Market, (U.S. League of Savings Institutions, 1983) p. 66.

C. HEDGING LIABILITIES

Thrift institutions generally rely on savings deposits as a source of liabilities to fund their assets. These savings deposits are usually a Money Market Certificate, which is a six-month deposit based on the 180-day Treasury bill and reprices or matures every six months. Because thrift's assets tend to be longer term investments in mortgages, there exists a classic mismatch of asset and liability maturities. As interest rates rise, the profit spread between assets and liabilities narrows and eventually becomes negative.

Thrift institutions could use the financial futures market to hedge the Money Market Certificates to lock in a cost of funds for their profit spread. It is almost a direct hedge, except T-bills are based on 90-day T-bills and the Money Market Certificate is based on the 180-day T-bill. Therefore, the thrift institution should short twice as many 90-day T-bill contracts as it has certificates outstanding. As interest rates on T-bills rise, the price of the T-bill futures would decline. The profit from the short position in the futures will offset the increased cost of borrowing when the Money Market certificates reprice.

For example:[21]

Cash Market	Futures Market
December 3, 1981	**December 3, 1981**
Institition originates $2,000,000 in 26-week deposit certificates at 11.274%.	Institution sells following 90-day U.S. Treasury bill futures contracts:
26-week interest cost $112,740.	$2,000,000 in March contract at 86.75, or $1,735,000.
	$2,000,000 in June contract at 86.90, or $1,738,000.

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[21] Ibid. p. 72.

	March 5, 1982
	Buys $2,000,000 in March contract at 87.96, or $1,759,200.
June 3, 1982	**June 1, 1982**
Rolls over certificates at 12.5%. Cost for next 26 weeks: $125,000.	Buys $2,000,000 in June contract at 88.14, or $1,762,800.
Pays higher interest cost for the next 26 weeks of $12,260.	Gain on March contract: $24,200.
	Gain on June contract: $24,800.
Net Gain on Hedge: $36,740.	

D. HEDGING MORTGAGE BANKING OPERATIONS

In recent years thrift institutions have become more active in selling their mortgages. FHA and VA mortgages originated by the thrift can be used to issue a GNMA certificate. To illustrate, a thrift commits to sell mortgages not yet originated. Should mortgage rates fall during the origination period, the thrift has to fill the commitment by discounting those loans made at lower rates. However, by doing a long hedge with financial futures, the thrift can lock in its position and protect its profit.

For example:[22]

Cash Market	**Futures Market**
March 24	**March 24**
Obtains a firm forward commitment to sell $2,000,000 in GNMAs at the current coupon of 12½% and the current price of 91-12, or $1,826,000.	Buys 27 GNMA-CDR September contracts at 66-12, or $1,790,100.

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22 Ibid. p. 70.

June 27	**June 27**
Cash market is 104, or $2,080,000.	Sells GNMA-CDR September contracts at 80-11, or $2,169,281.
Potential Loss: $254,000	Gain: $379,181
Net Gain on Hedge: $125,181	

Other situations regarding mortgage lending warrant hedging. When a thrift sells mortgages out of portfolio without a reinvestment for the proceeds, it can lock up a current yield by buying futures contracts at commitment date of the sale. So if rates decline, the gains in the hedge will offset the lesser yield on the reinvestment. Another hedge situation exists when an institution originates a mortgage loan without a commitment to sell it. To protect against rising interest rates, a thrift can create a short hedge by selling futures contracts. If rates increase the gain in the short hedge can be used to offset the loss on the sale of the loans. For example:[23]

Cash Market	**Futures Market**
June 1: The S & L makes commitments for $1 million mortgage pool based on current GNMA 16% cash price of 98-28.	**June 1:** The S & L sells 15* March 1982 GNMA futures contracts at 58-05.
January 1: The S & L sells $1 million of GNMA 16% to investors at 93-28.	**January 1:** The S & L buys 15 March 1982 contracts at 54-26.
Loss: $50,000 (5% of $1 million)	Gain: $50,156.25 (107/32 X 31.25 X 15)

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[23] Nancy Rothstein, ed. The Handbook of Financial Futures, (New York: McGraw-Hill, 1904), p. 130.

CHAPTER V

SUMMARY AND CONCLUSIONS

A. SUMMARY

The purpose of this study was to investigate hedging with financial futures as a method to reduce interest-rate risk for thrift institutions. Clearly, the past decade of interest-rate fluctuations has cost the thrift industry. The regulatory authorization has allowed thrifts to use hedging as a tool for more effective management of interest-rate risk.

Chapter I illustrated the damaging effect interest-rate risk has had on the net worth of the thrift industry. With most of their liabilities made up of short-term deposits and most of their assets consisting of long-term mortgages, there is a classic mismatch of maturities. Understanding the existing risks associated with rate volatility and this maturity mismatch and doing nothing about it is speculation by inertia. Hedgers can take futures positions equal and opposite of their cash position so the price change in one market offsets the price change in the other.

Chapter II explained the concept of hedging as a risk management process. The concept of basis showed that hedgers are speculators in that hedgers speculate on the basis. To assure that the hedge obtains equivalent dollar changes in both the cash and futures positions for the same interest rate change, the hedge needs to be structured to account for the maturity adjustment, the beta coefficients, the conversion, the contract month, and the contract specifications.

Chapter III described the different debt instruments used in the hedging process.

Chapter IV stated that the Federal Home Loan Bank Board authorized thrift institutions to engage in the futures transactions that reduce interest rate risk. To minimize the risk of increasing rates (decreasing value of assets), thrifts can sell futures to hedge their long position in assets. To minimize the additional costs of deposits when interest rates rise, thrifts can sell futures to offset the increased cost of deposits. Hedging with futures is used in mortgage banking operations also.

CONCLUSION

The central issue of this paper is that interest-rate risk needs to be managed. One thing certain about interest rates is that they will either go up or down. Hedging with financial futures transfers that risk to someone else.

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