Mortgage Rate Insurance:
Overview, Risk Management and Pricing

June 1982

MORTGAGE RATE INSURANCE:

OVERVIEW, RISK MANAGEMENT, AND PRICING

Prepared for

Canada Mortgage and Housing Corporation

By

George W. Gau and Dennis R. Capozza

University of British Columbia

June, 1982

EXECUTIVE SUMMARY

This study was commissioned by the Canada Mortgage and Housing Corporation to examine selected management and pricing aspects of mortgage rate insurance (MRI) protection. Chapter 1 consists of an overview of MRI and the workings of the financial futures markets. Chapter 2 examines operational considerations in the utilization of futures markets for MRI risk management. It also discusses options markets as another potentially useful mechanism for managing interest rate risks. Chapter 3 utilizes an option pricing model to estimate a premium structure for MRI. Chapter 4 summarizes the findings of the study and makes specific recommendations concerning the form and characteristics of MRI policies as well as the appropriate risk management strategy. It also explores how mortgage renewal insurance could be coupled with various alternatives mortgage instruments.

Overview

Since the late 1970s mortgage interest rates in Canada have exhibited a high degree of volatility. For the period of 1976 through 1981, the standard deviation of monthly interest rates on conventional mortgages is 2.93%, compared to only 1.07% during the years of 1971-75. This jump in interest rate volatility has significantly increased the risk inherent in residential mortgages at the times of commitment and renewal.

Market imperfections exist in the residential mortgage market which inhibit the efficient allocation of this risk between mortgage lenders and borrowers. Both parties to a mortgage face cash flow constraints which restrict their abilities to absorb high levels of interest rate risk. The burden has increasingly fallen on the mortgage borrower through the adoption of short-term rollover mortgages and variable-rate instruments.

There is a need for an alternative mechanism in the form of mortgage rate insurance (MRI) for shifting interest rate risk to a third party outside of the mortgage agreement. Two types of MRI policies could be offered to mortgage borrowers, commitment and renewal insurance. With MRI commitment policies, developers/investors in new real estate projects would receive protection against the risk of mortgage rates at the time of the exercise (takedown) of a floating-rate loan commitment being at a higher level than the commitment rate specified in the insurance contract. Under MRI renewal insurance if interest rates rise, the insurer pays the borrower the difference between the original mortgage payments and the higher payments required by the prevailing market rate of interest at the time of renewal.

Economies of scale and catastrophic risk are two economic justifications for government, as opposed to the private sector, creating and operating MRI. An MRI insurer in the form of a government instrumentality could span the entire mortgage market and be of sufficient size to benefit from economies of scale. The presence of a residual catastrophic risk (after futures hedging) with this insurance may require an emergency access to governmental borrowings by an MRI insurer.

Financial futures markets are a viable vehicle for hedging the risks created by volatile interest rates. Since their inception in 1975, these markets have grown in the U.S. and Canada to become a major hedging outlet for business and financial institutions. Basically, a futures transaction in these markets is the buying and selling at an agreed upon price a market-specified contract for a standardized amount of a commodity with delivery at a particular future date. To cover the costs or financial losses resulting from increases in interest rates, a futures hedger undertakes a "short" position by selling futures contracts. Then, if at a subsequent date interest rates rise, the hedger can close his original position by buying the futures contract at the lower price resulting from the rising interest rates.

At the present time there are five primary futures contracts for Canadian traders from the mortgage market: Canadian Treasury bills and bonds, U.S. GNMA securities, U.S. Treasury bonds, and Canadian dollars. The longest maturities of the outstanding futures contracts in these instruments range from six months to three years with contract denominations of either $100,000 or $1,000,000. Each futures exchange has established a clearinghouse to act as guarantor of contract performance. To ensure performance the clearinghouse requires margin deposits (1-2% of face value of contract) and daily settlements of net gains and losses on all futures positions. Transaction costs in the futures markets are in the area of $50 per contract.

Risk Management

A MRI insurer would be able to shift a substantial portion of the interest rate risk inherent in commitment and renewal policies to the financial futures markets. For a MRI insurer investing reserves in futures contracts, rising mortgage interest rates could not only cause a greater incidence of MRI claims, but also generate an offsetting cash inflow from rising values of short futures hedges. As an example, if mortgage renewal insurance with a 1% deductible was offered on all NHA mortgages originated in January 1976, the total MRI claim at the time of renewal of a five-year term (January 1981) would have been $2,497,288 (Canadian $). However, if hedging through U.S. GNMA futures contracts was utilized, the total gain on the futures hedge that would have been available to meet MRI renewal claims would have been $2,613,281 (U.S.$) less transaction costs of about $4,000 (U.S.$).

The present liquidity of the U.S. futures markets allows trades to take large hedging positions ($1 billion range) with terms of up to 2 years without seriously affecting market prices or the fear of being unable to close the position in subsequent periods. While the Canadian markets are young and still growing, the existing liquidity in these contracts limits trades to smaller futures positions ($1 million range) with hedge terms under a year. While instrument and basis relationships reduce hedging effectiveness, preliminary empirical tests indicate that 50-75% of the interest rate risk in MRI policies can potentially be hedged in the existing futures markets.

Hedging interest rate risk through futures markets is a more difficult task for an MRI insurer than for other hedgers due to the one-sided nature of the insurance. While there are MRI claims if interest rates rise, there are no direct gains in terms of cash inflows if interest rates fall. If the insurer is holding a short futures position when interest rates are declining, there are losses on the futures hedge that are not offset by insurance inflows beyond the initial premiums. The insurer must therefore lift hedges if interest rates fall. It is necessary to establish trading rules to place limits on any potential futures losses without substantially increasing transactions costs through the frequent opening and closing of futures positions.

Options markets can be another useful mechanism for hedging risk in MRI once active trading is initiated in debt instruments. Traders could utilize call and put options in mortgage or mortgage-like instruments to hedge interest rate risk. Unlike futures hedging, the downside loss in an options position is limited to the cost of the option. The limited loss potential in an option corresponds well to the MRI contract.

Option Pricing and Mortgage Rate Insurance

An options pricing model can be utilized to derive the risk premiums appropriate for MRI coverage. MRI is equivalent to a European put option, a sell option that can only be exercised at the end of the contract. Based on the characteristics of the mortgage and the MRI policy, as well as the volatility of interest rates, this pricing model derives the combination of MRI premium and interest rate deductible which produces sufficient reserves to compensate for the future MRI claims expected given the risk level being underwritten.

An examination of recent Canadian interest rates suggests that the present volatility level is approximately 3% (annual standard deviation). At this volatility the pricing model indicates a possible premium structure for MRI consisting of a risk premium of .5% of the mortgage balance with a 1 - 2% deductible depending on the term or commitment period of the insured mortgage. With a risk premium of 1%, the deductible on an MRI policy could fall to the .5% level.

Conclusion

The following is a list of the major conclusions and recommendations of this study with respect to mortgage rate insurance.

1. The results of this study indicate that MRI is an economically-feasible product that could be offered to borrowers to reduce their exposure to the risk of uncertain future mortgage payments.
2. Given the innovative nature of MRI, it is recommended that for optimal market acceptance the coverage under a MRI policy be governed by simple interest rate formulas as opposed to a CPI or anchor rate approach.
3. A MRI insurer should offer both commitment and renewal coverage on not only residential but also commercial properties.
4. Ultimately, a MRI insurer should offer mortgage borrowers a variety of insurance coverages with respect to premiums and deductibles. However, for marketing and management reasons, the insurer may want to limit the initial MRI policies to contracts with low premiums and large deductibles rather than high premiums and small or negative deductibles.
5. Given present interest rate volatility levels, the suggested MRI premium structure is a total premium (including administrative costs and reserves) of .75% of the insured mortgage balance with interest rate deductibles ranging from 2% (one-year term) to 1% (five-year term).
6. A MRI insurer should form a management group with responsibility for hedging the interest rate risk in MRI policies in the financial futures markets.

While MRI has been designed specifically for the standard rollover instrument, it could also be utilized with other alternative forms including the graduated-payment mortgage (GPM), shared-appreciation mortgage (SAM) and price-level-adjusted mortgage (PLAM). For most of these alternative designs the premium structure and risk management strategy in MRI would be essentially similar to the insurance on rollover instruments. The exception is the PLAM which, by only covering the risk of changes in the real mortgage rate, would create problems in futures hedging and require a new estimation of the risk premiums appropriate given the volatility of real interest rates.

CHAPTER 1 OVERVIEW

Borrowers and lenders in Canadian mortgage markets have experienced in recent years not only historically high levels of interest rates on residential mortgages, but also unprecedented volatility in mortgage interest rates over time. Fluctuating inflationary expectations as well as monetary policies directed toward controlling bank reserves rather than interest rates have combined to significantly increase interest rate variability and the levels of interest rate risk inherent in the standard housing finance arrangements. A potentially valuable approach to protecting borrowers and lenders from the risks resulting from this interest rate volatility is mortgage rate insurance (MRI). In essence with MRI a fee is paid to a third party, an insurer, to accept all or a portion of the interest rate risk inherent in a mortgage or any other debt instrument.

This chapter provides an overview of mortgage rate insurance, along with an introduction to financial futures markets. The first section of this chapter briefly reviews the problems created for mortgage borrowers and lenders by high levels of interest rate risk and some of the responses in the mortgage market to this financial environment in the form of alternative mortgage instruments. The second section examines the concept of mortgage rate insurance. It analyzes alternative MRI designs and discusses the required premium structure. An important hedging vehicle for interest rate risk, financial futures markets, is then described in the last section of this chapter. Included in this introduction to futures markets is a background on the workings of these markets and the mechanics of futures trading.

I. Interest Rate Risk

As indicated in Table 1-1, mortgage interest rates since the late 1970s have shown a high degree of volatility from month to month. For the period of 1976 through 1981, the standard deviation of monthly interest rates on conventional mortgages is 2.93 percent in Canada, compared to only 1.07 percent during the years of 1971-75. Since the October 1979 adoption of reserve targets by the U.S. Federal Reserve System, interest rate movements in Canadian markets have become quite pronounced with mortgage rates during 1981 ranging from 15 to over 21 percent.

Volatile interest rates increase the inherent risks in any contract where the returns (lenders) and costs (borrowers) are a function of uncertain interest rates.[1] For borrowers fluctuations in interest rates on loans cause the borrowing costs of debt to be unpredictable and generates concern that debt payment/income relationships may increase over the life of a loan. The two situations where mortgage borrowers can be seriously affected by interest rate risk are at the times of commitment and renewal.

Commitment and Renewal Risks

When a real estate developer is planning the construction of a residential or commercial project, it is common practice for the developer to seek a forward loan commitment from a lender. Under the terms of these commitments, the mortgage lender agrees to supply the permanent financing of the development upon the completion of the construction. Traditionally, these commitments have been offered at fixed interest rates -- the ultimate interest rate on the permanent mortgage is established at the time of the commitment. However, recent interest rate volatility has caused most lenders to offer only variable or floating-rate commitments whereby the interest rate is not set until the actual completion of the development. These variable-rate commitments force borrowers to assume the risk of unexpected increases in interest rates during the development period.

With the Canadian rollover mortgage, the lender absorbs the interest rate risk during the term of an existing mortgage, but the borrower bears the risk upon renewal of the mortgage at the end of its term. Borrowers are hedged from this risk to the degree that their incomes (whether employment income for homeowners or rental income for landlords) are responsive to interest rate changes during the term. If inflation alone determines the levels of not only interest rates but also nominal incomes and rents, borrowers are protected from the risk of higher mortgage payment-to-income ratios to the extent their incomes are indexed with respect to inflation. However, since nominal interest rates reflect anticipated, future inflation and not simply actual, past inflation, as well as changes in the real interest rate, mortgage rates could rise independent of incomes causing increases in the payment burden.

From the perspective of mortgage lenders, these institutions try to hedge their exposure to interest rate risk by matching the returns on their assets (mortgages) and the costs of their liabilities (deposits). This matching is achieved when the frequencies of interest rate adjustments are identical for their assets and liabilities. Table 1-2 gives a yearly breakdown from 1976-81 of the sources of funds (the liabilities) of two of the major lending institutions in the residential mortgage market, trust companies and mortgage loan companies.[2] As can be observed from this table, these lenders have experienced a noticeable shift in their liabilities toward shorter-term deposits. This shift, which has affected all financial intermediaries, has caused many mortgage lenders to only offer borrowers loans with much shorter terms -- often less than one year. In addition, many institutions have created types of variable-rate mortgages with monthly floating interest rates.

Cash Flow Constraints

In a world of perfect capital markets, the risks created by volatile interest rates would be reflected in the market equilibrium values of the alternative commitment and renewal terms of the residential mortgage. In other words, there would be a market price of interest rate risk at which either party to a mortgage would be indifferent among the various instrument characteristics. The higher the level of risk to either the lender or borrower from a particular mortgage design, the greater the risk premium required by the party to enter into the mortgage agreement.

In such a perfect market setting, risk premiums and therefore contract interest rates on different mortgage instruments would adjust until at equilibrium, interest rate risk is allocated among mortgage borrowers and lenders based on their risk/return preferences. Yet, observation of the residential mortgage market suggests there are market imperfections which inhibit such an efficient allocation of risk. Both borrowers and lenders face cash flow constraints which restrict the ability of either party to absorb high levels of interest rate risk.

Each party has limitations on its capacity to satisfy extended periods of large cash outflows and thus, independent of risk premiums, they may both prefer to reduce their exposure to risk. Most households lack the liquid wealth or debt capacity to quickly generate sufficient cash flows to meet the significant jumps in their debt service obligations that result from large increases in renewal interest rates. Similarly for lenders, regulatory authorities often require that mortgage income and deposit expense flows be equal in each period. Financial intermediaries with short-term deposits are therefore unable to offer long-term, fixed-rate mortgages even if they could charge a high risk premium.

Variable-Rate Mortgages

Given the existing cash flow constraints in the mortgage market, neither party to most residential mortgages wishes to absorb significant levels of interest rate risk. Over time the burden has increasingly fallen on the borrower through the adoption of short-term rollover mortgages and forms of variable-rate mortgages (VRM).

The distinguishing characteristic of the VRM is that the interest rate is not fixed for a specific term chosen by the mortgage borrower, but rather varies over the life of the loan based on changes in a "reference rate". Under a VRM, movements of the reference rate determine changes in the mortgage's interest rate, monthly payment, and/or amortization period. Financial institutions with short-term deposites are thus able to match their assets and liabilities position, and the risks resulting from volatile interest rates are shifted to the mortgage borrower.

The Canadian Imperial Bank of Commerce and the Royal Bank recently started offering their residential borrowers a form of dual-rate VRM.[3] With these VRM designs the mortgage interest rate changes monthly tied to movements of the bank's prime rate; however, the monthly mortgage payments are fixed for five years. If the prime rate rises above the rate utilized to calculate the monthly payment, the mortgage payments are not sufficient to cover the interest cost and the outstanding balance on the mortgage increases by the amount of the deficit. If market interest rates drop below the payment rate, less interest is assessed against the mortgage and a larger portion of the monthly payment is utilized to amortize the principal balance. Both the Commerce and Royal plans require borrowers to have a loan-to-value ratio no greater than 70% and include a graduated payment option which, under certain conditions, allow borrowers to reduce their initial mortgage payments by up to 20%.

By fixing the mortgage payments for five years, these VRM designs reduce the cash flow constraints on mortgage borrowers absorbing high levels of interest rate risk. Limitations on the maximum permitted loan-to-value ratio, however, generally restricts the potential market for these mortgages, especially regarding new entrants into the homeownership market. In addition, these loans may impose a cash flow problem on mortgage lenders if a large proportion of their portfolios consisted of these dual-rate VRMs. Since the cash inflows from the mortgage payments are fixed while the cash outflows for deposit interest are not, periods of rising interest rates could create cash flow imbalances for intermediaries with short-term liabilities, if depositors withdrew the interest credited to their account. For chartered banks such potential cash flow problems are probably not serious since only a small percentage of their assets consists of residential mortgages (approximately 7% of total assets in 1980). Yet, for institutions such as trust and mortgage loan companies with larger holdings of residential mortgages (69% and 81% of total assets, respectively), there could be a significant cash flow risk involved in the widespread offering of dual-rate VRMs.[4]

II. Mortgage Rate Insurance

Concept

An intriguing concept for immunizing mortgage borrowers from the interest rate risk inherent in commitment and renewal situations is mortgage rate insurance. Essentially, with an MRI commitment policy, the insurer in return for a specified premium would agree to compensate the borrower holding a floating-rate commitment for losses resulting from rising interest rates during the commitment period. With MRI renewal insurance if interest rates rise, the insurer pays the borrower (the insured) the difference between the original mortgage payments and the higher payments required by the prevailing market rate of interest at the time of renewal. Both policies can contain many insurance formula variations, as well as deductibles (ranges of interest rate changes that would require no insurance payments), to reduce the risk exposure of the insurer.[5]

To illustrate commitment insurance, assume a real estate developer is planning to construct an apartment building and receives a commitment from a mortgage lender to loan the developer $1,000,000 upon completion of construction in one year. The loan will have a five-year term and twenty-five year amortization with the interest rate to be set upon completion. At the present time market rates are expected to be at the 16% level with the developer exposed to the risk that interest rates could be higher.

An MRI commitment policy could be offered to the developer which would shift all or a portion of the risk to the insurer. With no deductible, the insurance would cover the losses created by interest rates rising above 16%. Then, if rates one year from now were at or below 16%, there would be no insurance claim. However, if rates rose above 16% to say 17%, the insurer would pay the incremental costs of the additional interest over the intial term of the loan. In this example at a 17% market rate the insurance claim would amount to $29,903.[6]

As an example of renewal insurance, assume a borrower has a $50,000 mortgage with a three-year term and twenty-five year amortization at a 17 1/2% interest rate. With a simple renewal policy containing a 1/2% deductible, the borrower could utilize MRI to protect against market rates at renewal being higher than 18%. In the case of a renewal rate of 20%, the borrower's monthly payments would rise from $715 (17 1/2%) to $805 (20%), but the insurance payout of $1,958 would lower the effective cost of the mortgage over the new three-year term to 18%.[7]

A concern that has at times been expressed regarding MRI is that such contracts are not really insurance in the conventional sense. Most common types of insurance such as life and property have the inherent characteristic of stochastic independence between losses on different individual contracts. Put another way, insurance is "an arrangement whereby the unfortunate few who lose are indemnified by the fortunate many who escape loss".[8] Insurance does not seem feasible in mortgage situations where all the insured lose at the same time due to a specific event (i.e., rising interest rates), except at excessive premiums.

To some degree MRI is not comparable to other types of insurance in that conventional risk sharing only takes place to a limited extent. In the absence of adverse selection by borrowers and interest rate trends, an MRI insurer would be able to spread interest rate risk over the insurance portfolio since borrowers over time would acquire the insurance at different points in an interest rate cycle. Therefore, only portions of the MRI policyholders would be exercising their commitments or renewing their mortgages at any given time. The possibility of adverse selection (borrowers only acquiring the insurance in periods of low interest rates) is reduced by the delay period implicit in MRI contracts. The insurance does not take effect until the end of either the commitment or the initial term of the mortgage, a period of sufficient length to prohibit accurate interest rate forecasting.

Interest rate trends, however, create a risk in MRI that cannot be diversified across policyholders. Rising interest rates over long periods would affect many contracts and an MRI insurer would need to have sufficient reserves to protect against such a contingency or, alternatively, be able to transfer this risk to other parties outside of the insurance contract. Other insurance forms besides MRI also have such a contingent claim in terms of a common loss across policyholders. For instance, portfolio insurance contracts are often offered separately or in combination with life insurance. These policies provide a benefit payable at maturity which is determined by the value of some specified portfolio of common stock with a minimum guaranteed return.[9] With such contracts all insured are affected by a downward trend in the stock market and the insurer faces a contingent claim in the form of the guarantee.

Role for Government

An outstanding question is whether there is a rationale for government, as opposed to the private sector, taking an innovative role in the establishment of mortgage rate insurance. The economic justification for such an active role by government can be found in at least two areas: (1) economies of scale; and (2) catastrophic risk.

The creation of MRI entails substantial start-up and management costs that must be recovered through the premiums on insured mortgages. To ensure such costs do not price the insurance out of the market, administrative expenses must be spread over a large number of insurance contracts. It is possible that at the present time no one private financial institution originates a sufficient volume of mortgages to generate the economies of scale necessary to make this insurance economically viable. The MRI insurer in the form of a governmental instrumentality could span the entire mortgage market and be of sufficient size to benefit from such economies.

Regarding the second justification, most general forms of insurance contain clauses which limit the liability of the insurer if certain catastrophic events occur during the term of the insurance -- often identified as "Acts of God", such perils can include floods, wars, and political revolutions. The reason these clauses are in the insurance contract is that the probability of the specified contingency occurring, or the loss associated with it, is not determinable by the insurer. For MRI such a catastrophic peril would be another major increase in the volatility of mortgage interest rates.

Assuming an MRI insurer cannot at the present time completely transfer interest rate risk to other parties and this catastrophic peril could not (or should not) be eliminated through contractural provisions, this insurance could retain a risk that a private insurer would have difficulty pricing or absorbing. Only a government insurer with an emergency access to the federal treasury may be in a position to initiate MRI insurance. A comparable situation originally existed with respect to mortgage default insurance. Such insurance is subject to a catastrophic peril in the form of a major depression resulting in widespread mortgage defaults. Only after it was clear that the likelihood of such an occurrence seemed small did private insurers begin offering default insurance.

Insurance Designs

The optimal formula for MRI commitment insurance would have the insurer offering policies protecting developers/investors in residential properties against the risk of mortgage rates at the time of the exercise of a floating-rate loan commitment being at a higher level than was expected when the insurance contract was issued.[10] The insurance protection should not attempt to cover the costs of expected increases in interest rates, but rather the risk of unanticipated jumps in mortgage rates. The idea is for the insurer to assume the interest rate risk previously found in fixed-rate commitments but not try to lower the anticipated interest costs of financing a residential development.

Commitment policies would basically have terms of 6 months to 2 years. Market information on the expected 1-2 year forward interest rates can be found in market yield curves (interest rates for different loan maturities) as well as yield/price data from the financial futures markets. Based on this information the insurance contract would state a commitment interest rate. Then, if the ultimate mortgage rate is above this contract rate, a claim is paid to lower the effective financing costs of the insured over the first term of the mortgage to the commitment rate. Deductibles, such as incremental interest points above the contract rate or limitations on the coverage (e.g., restricting payouts to 75% of any claim), could be included in the contract to require the borrower to participate in a portion of the risk.[11]

Two alternative approaches have been proposed for MRI renewal insurance. The first, identified as the anchor rate formula, relates the claim on the insurance policy to the difference between mortgage payments based on the market rate of interest prevailing at the time of renewal and those based on some anchor or reference interest rate derived from rates in periods prior to renewal. In the second design, called the CPI approach, the insurance claims are limited in some fashion to increases in mortgage payments greater than the changes in the consumer price index during the mortgage term.

-When compared to a simple renewal formula where insurance claims are made if the renewal interest rate is greater (with recognition of any deductible) than the original mortgage rate, both these proposed approaches attempt to add further limitations on the risk exposure of the MRI insurer. With the anchor rate formula a claim is only paid if the renewal rate is greater than the average mortgage rate during the previous 6-18 months.[12] The insurance therefore is only trying to protect borrowers who renew at high points of an interest rate cycle and essentially leaves them exposed to the risk of rising interest rates before the anchor calculation period. This approach implicitly assumes that mortgage borrowers are not subject to binding cash flow constraints and they are able to adjust to any increases in mortgage payments providing they have at least 6-18 months notice.

Under the CPI scheme, no claims would be payable by the insurer unless the percentage increase in the mortgage payments at renewal exceed 50-100% of the growth of the CPI. The MRI insurer with this approach is absorbing the risk of rising real interest rates and letting the borrower retain all or a portion of the interest rate risk resulting from changing inflationary expectations. To the degree that mortgage borrowers' incomes are inflation indexed, this residual risk not assumed by the insurer can be effectively hedged by a borrower and therefore does not represent a serious burden. However, for households whose incomes are not effectively indexed, the insured can retain a substantial level of risk under a CPI formula.

Premium Structure

The MRI insurance premium for both commitment and renewal coverage would basically consist of three components: (1) a risk compensation factor; (2) a catastrophic peril element; and, (3) a management expense margin. The risk factor in the premium is utilized to accumulate an insurance reserve to cover the predictable MRI claims given existing interest rate volatility and the degree of risk absorbed by the insurer. The catastrophic component would be included in the premium if the MRI insurer seeks to build a surplus as protection against the unpredictable contingency of a significant increase in future interest rate volatility. The third premium component is for covering the administrative expenses (and any profit margin) incurred in managing MRI insurance.

The largest factor of the MRI premium is probably the risk compensation component. While the catastrophic peril is a potentially major risk in this insurance, it is doubtful that an insurer could feasibly charge a relatively large premium factor to cover this contingency. A small catastrophic factor means it will take an MRI insurer a number of years to accumulate through the premium structure a sufficient catastrophic reserve. Unless this risk can be transferred to to others, it is quite likely that during the initial years of this insurance the insurer will have an uncovered position with respect to the catastrophic peril.

In a report to CMHC in September 1981, The Wyatt Company estimated the risk compensation factors required in a CPI-type of mortgage renewal insurance.[13] They found that the necessary premium factors would range from 1/2 to 1 percent of the outstanding loan balance on 1-to-5-year mortgage terms. In Chapter 3 of this study a contingent claims/option pricing model is applied to the derivation of the appropriate premium structure for MRI commitment and renewal policies.

An important issue affecting the MRI premium structure is whether there are financial mechanisms for shifting or transferring interest rate risk to other parties outside of the mortgage and insurance agreements. If the MRI insurer can effectively hedge the risk inherent in both commitment and renewal policies, then the problem of the catastrophic peril is diminished and lower risk compensation factors can be assessed in the premium. The remainder of this chapter (as well as Chapter 2) considers financial futures markets as a possible hedging mechanism.

III. Financial Futures Markets

A fairly recent innovation in the financial sector has been the creation of futures markets for financial instruments. Participants in these markets can speculate on the future movements of interest rates or hedge against the impact of adverse rate changes on the value of a financial position. This final section provides an overall introduction to financial futures markets and interest rate hedging, while the next chapter explores in detail the potential role of these markets in MRI risk management.

Background

The first futures contract in a debt instrument was offered in the United States by the Chicago Board of Trade in October 1975. Since that time futures contracts have been created in a wide array of instruments by a total of six U.S. commodity and stock exchanges. In Canada the Toronto and Montreal Stock Exchanges in September 1980 and the Winnipeg Commodity Exchange in February 1981 opened futures markets in financial instruments.

Table 1-3 provides a listing of the major financial futures markets offering currency, debt and equity instruments as of May 1982. Futures contracts have emerged in debt securities having a range of maturities. Market participants can speculate on or hedge against changes in short, medium and long-term interest rates. In addition, traders can utilize these markets to take futures positions with respect to movements of major exchange rates (including Canadian$/U.S.$ relationship) as well as changes in the overall level of the U.S. stock market.

Besides speculators attempting to profit from their prediction of future interest rates, a variety of business and financial institutions have become active participants in these markets as hedgers.[14] Many mortgage and security brokers utilize futures trading during the placement of a newly-issued debt instrument to protect their underwriting profits from the impact of fluctuating interest rates. Non-financial corporations often employ futures hedging in their working capital management. Some financial institutions take futures positions to offset potential declines in the market values of their debt portfolios if interest rates rise. Further, chartered banks and international traders commonly use the currency futures markets to hedge the risk of exchange rate movements.

Basically, a futures trade is the buying and selling at an agreed upon price a market-specified contract for a standardized amount of a commodity. What makes this transaction different from the normal economic trade is that the commodity is not delivered until a specific future date. The futures price therefore is the traders' expectation at the time of the transaction of the future market value of the commodity on the delivery date. Thus, the interaction of all traders in a futures market provides information regarding the market's expectations of the future commodity values that will prevail on various delivery dates.[15]

In the case of financial futures markets in debt instruments, the prices and yields on these contracts indicate the pattern of interest rates expected in future months by market participants.[16] Of course, the expected future rate represented by the yield on a futures contract is not necessarily the interest rate that will prevail at that future date, but simply the market prediction based on information known at the time. As additional information becomes available, changes in market expectations about subsequent interest rate levels causes movements in the transaction prices and the market values of futures contracts on debt instruments.

Hedging Positions

From a hedger's perspective there are two primary types of futures positions, "short" and "long". To cover the financial costs or losses resulting from increases in interest rates, a futures trader undertakes a short hedge by selling futures contracts. In situations where losses are suffered if rates decline, a trader creates a long hedge by buying futures contracts.

A futures hedge is generally made with the intent to close the futures position prior to the expiration (delivery date) of the contract. The futures position can be closed at any time prior to delivery by reversing the original transaction in the same exchange contract -- if short, buying the futures contract or if long, selling the contract. Though some market participants use futures positions as delivery vehicles to actually acquire or sell the financial instrument traded through the futures contract, only a small percentage of futures transactions result in delivery.

To demonstrate a short hedge, assume a financial institution wanted to protect against the declines in the market values of a debt portfolio that would result from rising interest rates. The hedger therefore acquires a short futures position by selling a futures contract. Then, if interest rates rise, the market values of both the debt portfolio and the futures contract fall. The hedger can close the futures position by buying the futures contract at a lower price than the original futures transaction. The futures gain offsets the loss suffered by the declining market value of the portfolio position. However, if interest rates fall and the values of debt securities rise, the hedger must close the futures position by purchasing now higher priced contracts, thereby losing on the futures trade and relinquishing gains experienced in the market value of the debt portfolio.

While interest rate volatility is commonly viewed only in terms of upside risk, some futures hedgers might also seek protection from falling rates. An example is a mortgage broker issuing a standby loan commitment at a fixed interest rate to a home builder with the broker having a forward sale agreement for the loan. If mortgage rates fall, the standby commitment would not be exercised and the mortgage broker must buy mortgages at higher prices (lower rates) to fulfill the sale agreement. If the mortgage broker takes a long futures position when issuing the standby commitment and interest rates fall, the hedger can close the futures transaction by selling the futures contracts at a higher price, creating a futures gain to compensate for the loss on the forward sale agreement.

It should be recognized that hedging in financial futures markets does not protect against losses created by anticipated changes in interest rates, since expected forward rates are embodied in the prices of futures contracts. If market expectations do not change and interest rates over time are exactly the same as the rates predicted by the market when the futures position was opened, there would be no futures gain or loss when the position is closed (ignoring basis changes, a topic covered in Chapter 2). Changes in market expectations and unanticipated movements of future interest rates are the sources of the interest rate risk that can be hedged in the financial futures market.

Mechanics of Futures Trading

A futures contract is simply an instrument indicating the holder agrees to make or take delivery of a commodity at a subsequent date. To facilitate their trading on organized exchanges, the terms of these agreements have been standardized with respect to contract specifications such as the characteristics and amounts of the commodities as well as the delivery dates. In addition, exchange regulations have been established to govern price movements, margin requirements and contract settlement.[1/]

The specifications of the five primary futures contracts for Canadian traders from the mortgage market are presented in Table 1-4. These contracts are denominated in either $100,000 or $1,000,000 increments with the required minimum maturities of the deliverable securities ranging from 90 days to 20 years. All five have four common delivery months each year -- March, June, September and December. At the present time the longest maturities of the outstanding futures contracts for each instrument are approximately: 6-9 months, Canadian Treasury bills and bonds; 33-36 months, U.S. Government National Mortgage Association (GNMA) mortgage-backed securities and U.S. Treasury bonds; and, 9-12 months, Canadian dollars.

For the futures contracts in long-term instruments, Treasury bonds and GNMA securities, the prices are quoted as a percent of par, 100 (e.g., for Canadian Treasury bonds, contract prices below 100-00 indicate a market yield greater than the coupon rate of 9%). The minimum price movement for these contracts is 1/32, where one 32nd (often called a "tick") equals $31.25 per $100,000 contract. Therefore, for instance, a price quotation of 97-06 means a market price of $97,187.50 for a $100,000 contract. In the case of Canadian Treasury bill futures where the underlying security has no coupon interest, prices are quoted at the discount price which an investor is prepared to pay today to receive $100 face value at maturity. For the Canadian dollar futures, prices are reported as the number of U.S. dollars expressed to four decimal points required to purchase one Canadian dollar.

To stabilize market activity the exchanges set limits on the maximum price advance or decline from the previous day's settlement price permitted for a contract in one trading session.[18] For example, for the long-term instruments the maximum daily price movement is $2,000 per contract. However, exchange regulations generally permit expansion of these limits under certain trading conditions, such as when price changes are consistently at the limit over a number of trading sessions.

Each futures exchange has established a clearinghouse to serve as the guarantor of contract performance. The fulfillment of contract obligations is guaranteed by the clearinghouse assuming the opposite side of each trade in the futures market. In other words, all buyers actually buy contracts from the clearinghouse and all sellers sell to the clearinghouse. After a transaction is completed in the trading pit of the futures exchange, the two parties to the transaction no longer deal with each other but instead only with the clearinghouse. To ensure performance the clearinghouse requires margin deposits and daily settlements of net gains and losses on all futures positions.

Whenever a position is opened, the buyer and seller of the futures contract must pay brokerage commissions (negotiable and in the range of $30-60 per contract) and clearinghouse charges (approximately $2 per contract). Further, they both are required to post a "good faith bond" in the form of cash or acceptable securities (such as Treasury bills). This earnest money is called the initial margin and is similar to the security deposits required when acquiring a property, except in this case the seller must also make a deposit. For bona fide hedgers initial margins are generally in the range of 1-2% of the face value of the contract. This money is returned to the trader when the futures position is offset through an opposite transaction in the same futures contract.

The clearinghouse requires daily settlement in cash for all price variations in every contract traded (a process referred to as "marking to the market"). Each day the clearinghouse credits the accounts of traders showing a net gain due to favorable price movements during that day's trading and debits the accounts of traders showing a net loss. If a loss causes the equity in the margin account to fall below a maintenance level (about 75% of the initial margin), the trader is required to deposit additional funds to return the account to the initial margin level. If a trader fails to respond to a margin call, the clearinghouse has the right to liquidate the position.

To help demonstrate the mechanics of futures trading, summaries of weekly positions in two examples of six-month hedges using actual futures prices are given in Tables 1-5 (Canadian Treasury bond futures) and 1-6 (U.S. GNMA futures). In each case it is assumed that the trader on July 8, 1981 takes a $1 million position in the March 1982 futures contract, completing the hedge by offsetting the position on December 23, 1981. The trader is assumed to short (sell) ten contracts, requiring initial and maintenance margins of $2,000 and $1,500 per contract, respectively. The transaction costs of these positions in the form of brokerage commissions and clearinghouse charges would be approximately $50 per contract.[19]

As shown in Table 1-5, prices on the March 1982 contract of Canadian Treasury bond futures fell from 61-10 on July 8, 1981 to 60-0 on December 23, 1981, earning for the hypothetical trader a profit of $13,125 (or $12,675 after transaction costs). The substantial volatility of interest rates and therefore futures prices during this period, however, caused the trader to face margins calls whenever price increases forced the current equity below the maintenance margin. The calls in this case were satisfied by the previous futures earnings until mid-November when the trader was required to invest additional funds in the futures position, a total of $38,437 by November 25. The interest or opportunity cost of these added funds (net of any interest earned on the early positive balances) would offset a portion of the futures profit in this example.

Similarly for the GNMA hedge in Table 1-6, rising U.S. interest rates during the second half of 1981 caused a drop in the prices of the futures contract, in this case resulting in a profit of $33,125 (U.S. $). A small proportion of this futures gain would again be offset by the costs of financing required margin investments of about $18,000 in November. Also, any change in the value of the Canadian dollar during this period would affect the above profit when it was converted from U.S. to Canadian funds.

These hedging transactions are, of course, only examples. Whether either of these positions would have been an optimal hedging strategy for a Canadian trader from the mortgage market requires further analysis of the liquidity and potential hedging effectiveness of the available futures markets.

CHAPTER 1

FOOTNOTES

1. An analysis of interest rate risk from the perspectives of both mortgage lenders and borrowers is provided in G.W. Gau, "An Examination of Alternatives to the Rollover Mortgage", Discussion Paper prepared for Canada Mortgage and Housing Corporation, June 1981; and D.R. Capozza and G.W. Gau, "Optimal Mortgage Instrument Designs," *North American Housing Markets into the Twenty-First Century*, edited by G.W. Gau and M.A. Goldberg (Cambridge, Massachusetts: Ballinger Publishing Company, 1982).

2. Trust and mortgage loan companies together in their asset portfolios had about 47% of all outstanding residential mortgages in 1980. Other institutions active in the residential mortgage market are chartered banks (25% of outstanding mortgages), credit unions (17%) and life insurance companies (11%) -- the source of these data is Canada Mortgage and Housing Corporation, *Canadian Housing Statistics*, 1981.

3. For background information on dual-rate VRMs, see D.R. Lessard and F. Modigliani, "Inflation and Residential Financing: Problems and Potential Solutions," *Capital Markets and the Housing Sector: Perspectives on Financial Reform*, edited by R.M. Buckley, J.A. Tuccillo, and K.E. Villani (Cambridge, Massachusetts: Ballinger Publishing Company, 1977).

4. Data on asset holdings by these financial institutions are taken from Canada Mortgage and Housing Corporation, Canadian Housing Statistics, 1981.

5. Two references regarding the overall concept of mortgage rate insurance are G.G. Kaufman, "The Case for Mortgage Rate Insurance," Journal of Money, Credit and Banking, 7(November 1975): 515-519; and, R. Edelstein and J. Guttentag, "Interest Rate Change Insurance and Related Proposals to Meet the Needs of Home Buyers and Home Mortgage Lenders in an Inflationary Environment," Capital Markets and the Housing Sector: Perspectives on Financial Reform, edited by R.M. Buckley, J.A. Tuccillo, and K.E. Villani (Cambridge, Massachusetts: Ballinger Publishing Company, 1977).

6. The monthly payments on a $1,000,000 mortgage with a twenty-five year amortization at 17% (interest compounded semi-annually) are $13,925 compared to $13,191 at a 16% interest rate. The present value of the $734 monthly difference over the five-year term discounted at 17% is $29,903.

7. The claim of $1,958 is the present value at the time of renewal of the difference in the monthly payments of $805 (20%) and $733 (18%) over the new three-year term.

8. R.I. Mehr and E. Cammack, Principles of Insurance, Fifth Edition (Homewood, Illinois: Richard D. Irwin, Inc., 1972): 38.

9. For an analysis of portfolio insurance, see M.J. Brennan and R. Solanki, "Optimal Portfolio Insurance," Journal of Financial and Quantitative Analysis 16(September 1981): 279-300.

10. It should be noted that both commitment and renewal forms of MRI could be offered on not only residential properties but also commercial developments such as office buildings and retail structures. Interest rate volatility is creating similar risks for mortgage borrowers financing investments in commercial properties. Broadening the insurance market could potentially increase the economies of scale discussed earlier.

11. From a moral hazard view, a deductible may be useful to protect the MRI insurer from intentional loss creation on the part of the insured. There is a potential in this insurance for collusion between the mortgage lender and borrower whereby the mortgage interest rate is set higher than market rates in return for the borrower receiving some other contractural benefits. A deductible would reduce the likelihood of such a moral hazard.

12. Unless an additional contractural limitation is specified, borrowers could be paid claims in this anchor rate approach even though their renewal rate and new mortgage payments are lower than the rate and payments during their original term -- so long as their mortgage rate at renewal is greater than the moving average rate.

13. The Wyatt Company, "Insurance Protection Against High Payment Increase on Mortgage Renewal: Further Research Work," September 28, 1981.

14. "Banks Should Look to the Futures," Fortune, April 20, 1981; and "Financial Futures Surge as Banks, Industrial Firms Move into Market," Wall Street Journal, March 23, 1982.

15. A.E. Burger, R.W. Lang, and R.H. Rasche, "The Treasury Bill Futures Market and Market Expectations of Interest Rates," Review, Federal Reserve Bank of St. Louis, June 1977.

16. There is a long-lived controversy regarding whether the yields on futures contracts are upward-biased estimates of expected future interest rates. Some researchers argue that speculators require a risk premium for assuming the risk of possible interest rate fluctuations and therefore only buy contracts with yields higher than the expected future interest rate. Others insist that futures prices contain no risk premium and reflect solely market expectations. Two early contributions to this argument can be found in H.S. Houthakker, "Can Speculators Forecast Prices?," Review of Economics and Statistics (May 1957): 143-151; and L.G. Telser, "Futures Trading and the Storage of Cotton and Wheat," Journal of Political Economy (June 1958): 233-255.

17. Sources of information on the mechanics of futures trading include Chicago Board of Trade publications such as Hedging Interest Rate Risks (1977) and M.J. Powers and D.J. Vogel, Inside the Financial Futures Markets (New York: John Wiley and Sons, 1981).

18. The settlement price of a futures contract is set by the exchange based upon that day's closing price or range in closing prices and is utilized to determine net gains or losses on all outstanding contracts.

19. Information on required margin levels and transaction costs was supplied by Victor Adair at ContiCommodity in Vancouver.

TABLE 1-1

Residential Mortgage Interest Rates*

	Year					
Month	1976	1977	1978	1979	1980	1981
January	11.84%	10.75%	10.32%	11.28%	13.26%	15.17%
February	11.80	10.25	10.31	11.25	13.50	15.27
March	11.90	10.25	10.33	11.11	14.69	15.75
April	12.03	10.25	10.41	11.05	16.94	16.45
May	11.99	10.38	10.43	11.06	13.99	17.82
June	11.93	10.35	10.32	11.16	12.92	18.55
July	11.86	10.40	10.31	11.20	13.09	18.90
August	11.83	10.33	10.31	11.80	13.44	21.30
September	11.76	10.32	10.67	12.25	14.50	21.46
October	11.60	10.34	10.95	13.50	14.87	20.54
November	11.56	10.34	11.25	14.46	15.00	18.80
December	11.27	10.33	11.53	13.58	15.60	17.79

*Average of prime conventional mortgage interest rate

Source: Canadian Housing Statistics (selected issues)

Canada Mortgage and Housing Corporation.

TABLE 1-2
Sources of Funds:
Trust and Mortgage Loan Companies
(in % of total sources)

Source	1976	1977	1978	1979	1980	1981*
Savings Deposits						
Chequable	2.9%	2.9%	2.7%	2.2%	2.8%	2.7%
Non-chequable	11.4	11.9	11.1	13.2	13.0	11.4
Term Deposits & GICs						
Less than 1-year terms	6.0	5.8	6.8	8.5	7.9	11.9
1-to 5-year terms	59.7	57.8	57.7	55.6	55.7	52.5
Over 5-year terms	2.4	2.5	2.5	2.0	1.8	1.8
Debentures and Notes	4.4	5.5	5.6	6.4	6.7	7.0
Other Liabilities	7.1	7.7	7.9	6.7	6.7	7.9
Shareholder's Equity	6.1	5.9	5.7	5.4	5.4	4.8

*Through third quarter of year

Source: Bank of Canada Review, March 1982.

TABLE 1-3
Financial Futures Markets

	Instrument	Exchange*	Start of Trading
1.	Major international currencies (including Canadian dollar)	IMM	1972
2.	U.S. Government National Mortgage Association (GNMA) certificates	CBT	1975
3.	90-day U.S. Treasury bills	IMM	1976
4.	U.S. Treasury bonds	CBT	1977
5.	90-day U.S. commercial paper	CBT	1977
6.	1-year U.S. Treasury bills	IMM	1978
7.	4-year U.S. Treasury notes	IMM	1979
8.	91-day Canadian Treasury bills	TME	1980
9.	Canadian Treasury bonds	TME	1980
10.	90-day U.S. bank certificates of deposit	CBT IMM	1980
11.	U.S. Government National Mortgage Association (GNMA) certificates	NYFE	1980
12.	U.S. Treasury bonds	NYFE	1980
13.	Canadian Treasury bills	WCE	1981
14.	Canadian Treasury bonds	WCE	1981
15.	Eurodollars	IMM	1981
16.	Value Line stock index	KCBT	1982
17.	NYSE composite stock index	NYFE	1982

*Exchanges:
IMM - International Monetary Market at Chicago Mercantile Exchange
CBT - Chicago Board of Trade
TME - Toronto and Montreal Stock Exchange
NYFE- New York Futures Exchange (subsidiary of New York Stock Exchange
WCE - Winnipeg Commodity Exchange
KCBT- Kansas City Board of Trade

TABLE 1-4
Specifications of Major Futures Contracts

Contract and Exchange[1]	Instrument Characteristics	Minimum Price Changes	Maximum Daily Price Movement[2]
Canadian Treasury Bills TME	91 days maturity $1 million face value	$.005; $50 (per contract)	$.125; $1,250 (per contract)
Canadian Treasury Bonds TME	18 years maturity $100,000 face value 9% coupon	1/32 of a point; $31.25	2 points; $2,000
U.S. GNMA Securities CBT	$100,000 face value 8% coupon	1/32 of a point; $31.25	2 points; $2,000
U.S. Treasury Bonds CBT	20 years maturity $100,000 face value 8% coupon	1/32 of a point; $31.25	2 points; $2,000
Canadian Dollars IMM	$100,000 face value (in Canadian $)	.0001 US $ per C$; $10 (US)	

[1] Exchanges: TME - Toronto - Montreal Exchange
IMM - International Monetary Market at Chicago Mercantile Exchange
CBT - Chicago Board of Trade.

[2] Each Exchange has regulations expanding daily price limits under certain trading conditions.

HEDGING ANALYSIS

TABLE 1-5
CANADIAN TREASURY BOND FUTURES
SUMMARY OF WEEKLY POSITIONS
JULY 1981 TO DECEMBER 1981

CONTRACT:
CTB MARCH 82 8/7/81 - 23/12/81

DATE (DD/MM/YY)	15/ 7/81	22/ 7/81	29/ 7/81	5/ 8/81	12/ 8/81
PRIOR CLOSING PRICE	61-10	60-12	58- 5	54-22	56- 0
SETTLEMENT PRICE	60-12	58- 5	54-22	56- 0	58-20
TICKS PER CONTRACT	-30	-71	-111	42	84
NUMBER OF CONTRACTS	-10	-10	-10	-10	-10
GROSS PROFIT (LOSS)	$ 9375	$ 22188	$ 34688	$ -13125	$ -26250

MARGIN CALLS:

	15/ 7/81	22/ 7/81	29/ 7/81	5/ 8/81	12/ 8/81
INITIAL MARGIN	$ 20000	$ 20000	$ 20000	$ 20000	$ 20000
CURRENT EQUITY	20000	20000	20000	6875	-6250
MAINTENANCE MARGIN	15000	15000	15000	15000	15000
MARGIN CALL				$ 13125	$ 6250
AMOUNT ADDED TO (SUBTRACTED FROM) CUSTOMER ACCOUNT	$ 29375	$ 22188	$ 34688	$ -13125	$ -26250
ACCOUNT BALANCE	$ 29375	$ 51563	$ 86250	$ 73125	$ 46875
AMOUNT IN EXCESS OF INITIAL MARGIN	$ 9375	$ 31563	$ 66250	$ 53125	$ 26875

HEDGING ANALYSIS

TABLE 1-5
CANADIAN TREASURY BOND FUTURES
SUMMARY OF WEEKLY POSITIONS
JULY 1981 TO DECEMBER 1981

CONTRACT:
CTB MARCH 82 8/7/81 - 23/12/81

DATE (DD/MM/YY)	19/ 8/81	26/ 8/81	2/ 9/81	9/ 9/81	16/ 9/81
PRIOR CLOSING PRICE	58-20	57-28	55-16	55-25	54-28
SETTLEMENT PRICE	57-28	55-16	55-25	54-28	56- 6
TICKS PER CONTRACT	-24	-76	9	-29	42
NUMBER OF CONTRACTS	-10	-10	-10	-10	-10
GROSS PROFIT (LOSS)	$ 7500	$ 23750	$ -2812	$ 9063	$ -13125
MARGIN CALLS:					
INITIAL MARGIN	$ 20000	$ 20000	$ 20000	$ 20000	$ 20000
CURRENT EQUITY	20000	20000	17188	17188	4063
MAINTENANCE MARGIN	15000	15000	15000	15000	15000
MARGIN CALL					$ 15938
AMOUNT ADDED TO (SUBTRACTED FROM) CUSTOMER ACCOUNT	$ 7500	$ 23750	$ 0	$ 9063	$ -15937
ACCOUNT BALANCE	$ 54375	$ 78125	$ 78125	$ 87188	$ 71250
AMOUNT IN EXCESS OF INITIAL MARGIN	$ 34375	$ 58125	$ 58125	$ 67188	$ 51250

HEDGING ANALYSIS

TABLE 1-5
CANADIAN TREASURY BOND FUTURES
SUMMARY OF WEEKLY POSITIONS
JULY 1981 TO DECEMBER 1981

CONTRACT:
CTB MARCH 82 8/7/81 - 23/12/81

DATE (DD/MM/YY)	23/ 9/81	30/ 9/81	7/10/81	14/10/81	21/10/81
PRIOR CLOSING PRICE	56- 6	53-28	52- 8	55-20	55- 8
SETTLEMENT PRICE	53-28	52- 8	55-20	55- 8	54-28
TICKS PER CONTRACT	-74	-52	108	-12	-12
NUMBER OF CONTRACTS	-10	-10	-10	-10	-10
GROSS PROFIT (LOSS)	$ 23125	$ 16250	$ -33750	$ 3750	$ 3750
MARGIN CALLS:					
INITIAL MARGIN	$ 20000	$ 20000	$ 20000	$ 20000	$ 20000
CURRENT EQUITY	20000	20000	-13750	20000	20000
MAINTENANCE MARGIN	15000	15000	15000	15000	15000
MARGIN CALL			$ 33750		
AMOUNT ADDED TO (SUBTRACTED FROM) CUSTOMER ACCOUNT	$ 23125	$ 16250	$ -33750	$ 3750	$ 3750
ACCOUNT BALANCE	$ 94375	$ 110625	$ 76875	$ 80625	$ 84375
AMOUNT IN EXCESS OF INITIAL MARGIN	$ 74375	$ 90625	$ 56875	$ 60625	$ 64375

HEDGING ANALYSIS

TABLE 1-5
CANADIAN TREASURY BOND FUTURES
SUMMARY OF WEEKLY POSITIONS
JULY 1981 TO DECEMBER 1981

CONTRACT:
CTB MARCH 82 8/7/81 - 23/12/81

DATE (DD/MM/YY)	28/10/81	4/11/81	11/11/81	18/11/81	25/11/81
PRIOR CLOSING PRICE	54-28	55-22	60-14	63-14	62-19
SETTLEMENT PRICE	55-22	60-14	63-14	62-19	65- 5
TICKS PER CONTRACT	26	152	96	-27	82
NUMBER OF CONTRACTS	-10	-10	-10	-10	-10
GROSS PROFIT (LOSS)	$ -8125	$ -47500	$ -30000	$ 8438	$ -25625
MARGIN CALLS:					
INITIAL MARGIN	$ 20000	$ 20000	$ 20000	$ 20000	$ 20000
CURRENT EQUITY	11875	-27500	-10000	20000	-5625
MAINTENANCE MARGIN	15000	15000	15000	15000	15000
MARGIN CALL	$ 8125	$ 47500	$ 30000		$ 25625
AMOUNT ADDED TO (SUBTRACTED FROM) CUSTOMER ACCOUNT	$ -8125	$ -47500	$ -30000	$ 8438	$ -25625
ACCOUNT BALANCE	$ 76250	$ 28750	$ -1250	$ 7188	$ -18437
AMOUNT IN EXCESS OF INITIAL MARGIN	$ 56250	$ 8750	$ -21250	$ -12812	$ -38437

HEDGING ANALYSIS

TABLE 1-5
CANADIAN TREASURY BOND FUTURES
SUMMARY OF WEEKLY POSITIONS
JULY 1981 TO DECEMBER 1981

CONTRACT:
CTB MARCH 82 8/7/81 - 23/12/81

DATE (DD/MM/YY)	2/12/81	9/12/81	16/12/81	23/12/81
PRIOR CLOSING PRICE	65- 5	64-23	62-30	62- 4
SETTLEMENT PRICE	64-23	62-30	62- 4	60- 0
TICKS PER CONTRACT	-14	-57	-26	-68
NUMBER OF CONTRACTS	-10	-10	-10	-10
GROSS PROFIT (LOSS)	$ 4375	$ 17813	$ 8125	$ 21250

MARGIN CALLS:

	2/12/81	9/12/81	16/12/81	23/12/81
INITIAL MARGIN	$ 20000	$ 20000	$ 20000	$ 20000
CURRENT EQUITY	20000	20000	20000	20000
MAINTENANCE MARGIN	15000	15000	15000	15000
MARGIN CALL				
AMOUNT ADDED TO (SUBTRACTED FROM) CUSTOMER ACCOUNT	$ 4375	$ 17813	$ 8125	$ 21250
ACCOUNT BALANCE	$ -14062	$ 3750	$ 11875	$ 33125
AMOUNT IN EXCESS OF INITIAL MARGIN	$ -34062	$ -16250	$ -8125	$ 13125

HEDGING ANALYSIS

PAGE 1

TABLE 1-6
US GNMA FUTURES (US$)
SUMMARY OF WEEKLY POSITIONS
JULY 1981 TO DECEMBER 1981

CONTRACT:
GNMA MARCH 82 7/81 TO 12/81

DATE (DD/MM/YY)	15/ 7/81	22/ 7/81	29/ 7/81	5/ 8/81	12/ 8/81
PRIOR CLOSING PRICE	62-31	62-28	61- 2	60-28	60- 6
SETTLEMENT PRICE	62-28	61- 2	60-28	60- 6	61- 4
TICKS PER CONTRACT	-3	-58	-6	-22	30
NUMBER OF CONTRACTS	-10	-10	-10	-10	-10
GROSS PROFIT (LOSS)	$ 938	$ 18125	$ 1875	$ 6875	$ -9375
MARGIN CALLS:					
INITIAL MARGIN	$ 20000	$ 20000	$ 20000	$ 20000	$ 20000
CURRENT EQUITY	20000	20000	20000	20000	10625
MAINTENANCE MARGIN	15000	15000	15000	15000	15000
MARGIN CALL					$ 9375
AMOUNT ADDED TO (SUBTRACTED FROM) CUSTOMER ACCOUNT	$ 20938	$ 18125	$ 1875	$ 6875	$ -9375
ACCOUNT BALANCE	$ 20938	$ 39063	$ 40938	$ 47813	$ 38438
AMOUNT IN EXCESS OF INITIAL MARGIN	$ 938	$ 19063	$ 20938	$ 27813	$ 18438

HEDGING ANALYSIS

TABLE 1-6
US GNMA FUTURES (US$)
SUMMARY OF WEEKLY POSITIONS
JULY 1981 TO DECEMBER 1981

CONTRACT:
GNMA MARCH 82 7/81 TO 12/81

DATE (DD/MM/YY)	19/ 8/81	26/ 8/81	2/ 9/81	9/ 9/81	16/ 9/81
PRIOR CLOSING PRICE	61- 4	59-22	57-22	57-16	56-29
SETTLEMENT PRICE	59-22	57-22	57-16	56-29	58- 8
TICKS PER CONTRACT	-46	-64	-6	-19	43
NUMBER OF CONTRACTS	-10	-10	-10	-10	-10
GROSS PROFIT (LOSS)	$ 14375	$ 20000	$ 1875	$ 5938	$ -13437
MARGIN CALLS:					
INITIAL MARGIN	$ 20000	$ 20000	$ 20000	$ 20000	$ 20000
CURRENT EQUITY	20000	20000	20000	20000	6563
MAINTENANCE MARGIN	15000	15000	15000	15000	15000
MARGIN CALL					$ 13438
AMOUNT ADDED TO (SUBTRACTED FROM) CUSTOMER ACCOUNT	$ 14375	$ 20000	$ 1875	$ 5938	$ -13437
ACCOUNT BALANCE	$ 52813	$ 72813	$ 74688	$ 80625	$ 67188
AMOUNT IN EXCESS OF INITIAL MARGIN	$ 32813	$ 52813	$ 54688	$ 60625	$ 47188

HEDGING ANALYSIS

TABLE 1-6
US GNMA FUTURES (US$)
SUMMARY OF WEEKLY POSITIONS
JULY 1981 TO DECEMBER 1981

CONTRACT:
GNMA MARCH 82 7/81 TO 12/81

DATE (DD/MM/YY)	23/ 9/81	30/ 9/81	7/10/81	14/10/81	21/10/81
PRIOR CLOSING PRICE	58- 8	57-15	55-12	58- 6	58-30
SETTLEMENT PRICE	57-15	55-12	58- 6	58-30	57-18
TICKS PER CONTRACT	-25	-67	90	24	-44
NUMBER OF CONTRACTS	-10	-10	-10	-10	-10
GROSS PROFIT (LOSS)	$ 7813	$ 20938	$ -28125	$ -7500	$ 13750

MARGIN CALLS:

	23/ 9/81	30/ 9/81	7/10/81	14/10/81	21/10/81
INITIAL MARGIN	$ 20000	$ 20000	$ 20000	$ 20000	$ 20000
CURRENT EQUITY	20000	20000	-8125	12500	20000
MAINTENANCE MARGIN	15000	15000	15000	15000	15000
MARGIN CALL			$ 28125	$ 7500	
AMOUNT ADDED TO (SUBTRACTED FROM) CUSTOMER ACCOUNT	$ 7813	$ 20938	$ -28125	$ -7500	$ 13750
ACCOUNT BALANCE	$ 75000	$ 95938	$ 67813	$ 60313	$ 74063
AMOUNT IN EXCESS OF INITIAL MARGIN	$ 55000	$ 75938	$ 47813	$ 40313	$ 54063

HEDGING ANALYSIS

TABLE 1-6
US GNMA FUTURES (US$)
SUMMARY OF WEEKLY POSITIONS
JULY 1981 TO DECEMBER 1981

CONTRACT:
GNMA MARCH 82 7/81 TO 12/81

DATE (DD/MM/YY)	28/10/81	4/11/81	11/11/81	18/11/81	25/11/81
PRIOR CLOSING PRICE	57-18	57- 2	61-11	63-10	64-25
SETTLEMENT PRICE	57- 2	61-11	63-10	64-25	65- 9
TICKS PER CONTRACT	-16	137	63	47	16
NUMBER OF CONTRACTS	-10	-10	-10	-10	-10
GROSS PROFIT (LOSS)	$ 5000	$ -42812	$ -19687	$ -14687	$ -5000
MARGIN CALLS:					
INITIAL MARGIN	$ 20000	$ 20000	$ 20000	$ 20000	$ 20000
CURRENT EQUITY	20000	-22812	313	5313	15000
MAINTENANCE MARGIN	15000	15000	15000	15000	15000
MARGIN CALL		$ 42813	$ 19688	$ 14688	
AMOUNT ADDED TO (SUBTRACTED FROM) CUSTOMER ACCOUNT	$ 5000	$ -42812	$ -19687	$ -14687	$ 0
ACCOUNT BALANCE	$ 79063	$ 36250	$ 16563	$ 1875	$ 1875
AMOUNT IN EXCESS OF INITIAL MARGIN	$ 59063	$ 16250	$ -3437	$ -18125	$ -18125

HEDGING ANALYSIS

TABLE 1-6
US GNMA FUTURES (US$)
SUMMARY OF WEEKLY POSITIONS
JULY 1981 TO DECEMBER 1981

CONTRACT:
GNMA MARCH 82 7/81 TO 12/81

DATE (DD/MM/YY)	2/12/81	9/12/81	16/12/81	23/12/81
PRIOR CLOSING PRICE	65- 9	62-30	61-16	62-12
SETTLEMENT PRICE	62-30	61-16	62-12	59-21
TICKS PER CONTRACT	-75	-46	28	-87
NUMBER OF CONTRACTS	-10	-10	-10	-10
GROSS PROFIT (LOSS)	$ 23438	$ 14375	$ -8750	$ 27188
MARGIN CALLS:				
INITIAL MARGIN	$ 20000	$ 20000	$ 20000	$ 20000
CURRENT EQUITY	15000	15000	6250	20000
MAINTENANCE MARGIN	15000	15000	15000	15000
MARGIN CALL			$ 13750	
AMOUNT ADDED TO (SUBTRACTED FROM) CUSTOMER ACCOUNT	$ 23438	$ 14375	$ -13750	$ 27188
ACCOUNT BALANCE	$ 25313	$ 39688	$ 25938	$ 53125
AMOUNT IN EXCESS OF INITIAL MARGIN	$ 5313	$ 19688	$ 5938	$ 33125

CHAPTER 2 RISK MANAGEMENT

The creation of mortgage rate insurance (MRI) would require an insurer to develop a strategy for risk management. Such an insurer would need to evaluate the alternative mechanisms available for hedging the interest rate risks inherent in MRI policies. This chapter closely examines operational considerations in the utilization of financial futures markets for risk management. The first section contains a conceptual analysis of the potential role of financial futures market in MRI management. The following section evaluates MRI hedging strategy through an examination of three important issues: (1) liquidity of existing markets; (2) instrument and basis relationships; and, (3) expected hedging effectiveness. The final section briefly considers another potentially useful mechanism for managing interest rate risks, option markets.

I. Potential Role of Financial Futures Markets

As discussed in Chapter 1 of this study, financial futures markets have been created to enable traders to offset or hedge any financial losses resulting from fluctuating interest rates. For an MRI insurer investing reserves in futures contracts, rising mortgage interest rates could not only cause greater incidences of MRI claims, but also generate an offsetting cash inflow from rising values of a short futures position. In terms of commitment insurance, the insurer could hedge the interest rate risk inherent in such a policy by acquiring short futures positions for the period of time from origination to takedown of the commitment. Then, if market interest rates rise to a level higher than the commitment rate, the gains on the futures position could be utilized to finance the MRI claim, the payout required to keep the borrower's effective mortgage rate at the commitment level.

With any of the renewal insurance formulas, the MRI risk exposure (and therefore the appropriate time for a short futures positions) is during the period from the start of the insurance until mortgage renewal. Similar to the commitment situation, rising mortgage rates in a short futures hedge would then result in futures profits being available to compensate borrowers for higher mortgage payments at renewal. In the CPI approach, however, the insurer's risk is in terms of rising real, as opposed to nominal interest rates. With the insurance claims being in some form limited to increases in mortgage payments greater than changes in the CPI, the insurer would only need to hedge increases in the real mortgage rate, while existing futures contracts are denominated in nominal interest rates. Short futures positions could thus potentially over-hedge MRI insurers with CPI renewal policies since increases in nominal interest rates (and therefore the market values of short futures positions) resulting from higher inflation would not necessarily cause a corresponding insurance outflow.

Similarly, the anchor rate formula also represents a potential over-hedge. The MRI insurer would only compensate the mortgage borrower (after deductibles) for increases in mortgage interest rates during the period when the anchor rate is being calculated (e.g., the twelve months prior to renewal) that are greater than the average mortgage rate for that period. However, the gain on the short futures position would be based on the entire rise of mortgage rates.

Of the alternative renewal insurance designs, a simple interest rate formula would be the most straightforward hedge in the existing futures markets. Under such a scheme, a MRI claim would be paid if the mortgage renewal rate is greater (by more than a contractually-specified deductible) than the original mortgage rate of the insured. This type of formula alleviates the over-hedge potential of the more complicated renewal approaches and allows MRI insurers to generally consider futures hedge ratios of one -- a $1 futures position for each $1 insured mortgage balance.

MRI Hedging Example

To demonstrate the potential role of futures markets in MRI risk management, assume that mortgage renewal insurance was offered in January 1976 and every NHA borrower originating a loan that month acquired a straight renewal policy with a 1% deductible on a five-year term mortgage. A total of 1,142 NHA mortgages originated in January 1976 with an average interest rate of 11.75% and an average loan balance of $32,925 (total insured balance of $37,600,350).[1] The loans come up for renewal in January 1981.

The MRI insurer of these mortgages would want to enter a futures hedge if mortgage rates rose above 12.75% (origination rate plus the deductible). NHA mortgage rates did not rise to 12.75% until the first week of October 1979. Assume on October 3, 1979 the insurer sold 75 U.S. GNMA futures contracts (face value of $37.5 million U.S.) with maturity of March 1981 for market price that day of 78-12.

From October 1979 to January 1981 weekly NHA rates remained above 12.75%. On January 7, 1981 the insurer closed the futures position by purchasing 75 March 1981 GNMA contracts for prevailing market price of 71-13. Table 2-1 shows a monthly summary of the results of this futures hedge.

The total gain on the futures hedge that would have been available to meet MRI renewal claims would have been $2,613,281 (U.S.) less transaction costs of about $4,000 (U.S.). In January 1981 the average NHA mortgage rate was 15.17%. With a 1% deductible the total MRI claim to lower the effective rate on the 1,142 loans to 12.75% over a new five-year term would have been $2,497,288 (Canadian).

Limitations

If all of the interest rate risk inherent in an MRI policy could be perfectly offset in the futures markets, an insurer could simply act as a risk intermediary, absorbing risk from mortgage borrowers and then totally hedging it through short futures positions. There would be no catastrophic peril not compensated for in the MRI premiums since all risk would be shifted to the futures markets. In fact, in the perfect hedge case, the MRI premiums would require no risk compensation element at all and would only need to cover the administrative expenses of the insurance, including the transactions costs of futures trading.

However, perfect hedges are not possible in the financial futures markets. While more fully analyzed in the next section of this chapter, Canadian residential mortgages are presently not traded in any existing futures market and therefore the instrument relationships between the insurance contract and the futures contract are not perfect -- in other words, a given increase in interest rates can result in a gain on a short futures position not equal to the amount of the MRI claim. In addition, for technical reasons, there can be shifts in the spot/futures (basis) relationships which can further hamper hedging effectiveness. While the impact of these factors on an MRI insurer can at least be partially reduced through proper hedging strategy, a Canadian insurer with large mortgage positions faces at the present time liquidity limitations in Canadian futures markets and will likely be able to hedge only a portion of the risk inherent in MRI policies. Therefore, the insurance premium still requires a risk compensation factor greater than zero, although generally lower than the level required with no risk management through futures hedging.

Also, hedging interest rate risk through futures markets in a more difficult task for an MRI insurer than for other hedgers due to the one-sided nature of the insurance contract. The MRI position is not a pure hedge situation. While the MRI insurer has claims if interest rates rise, there are no direct gains in terms of cash inflows if interest rates fall. If the insurer is holding a short futures position when interest rates are declining, there are losses on the futures position which are not offset by insurance inflows. The insurer must therefore lift hedges (close the short positions) if interest rates are in a downward trend. These timing decisions are not simple and they are subject to error given the problems in forecasting interest rate trends. Trading rules can assist in this aspect of risk management. For example, with a simple interest rate formula containing a 1% deductible, a useful trading procedure might be to only acquire a short futures position if interest rates rise above the contract mortgage rate plus 1% and sell the futures position if rates fall below the contract rate. The idea would be for the MRI insurer to establish limits on any potential futures losses from falling interest rates without substantially increasing transaction costs through the frequent opening and closing of futures positions.

To illustrate the operation of this trading rule, assume that in March 1980 mortgage renewal insurance was available and all the 2,206 NHA mortgages originated that month acquired a 1% deductible policy. The total mortgage balance subject to MRI insurance would be approximately $108,800,000 with an interest rate of 15%. The futures trading rule for the MRI insurer would be to hedge if mortgage rates rise above 16% and close the position if rates fall below 16%.

During the first week of April 1980, NHA rates rose to 16-16 1/2% level. Assume on April 9, 1980 the insurer sold 217 U.S. GNMA futures contracts (face value of $108.5 million U.S.) with maturity of March 1982 for going price of 71-25. During the last week of April 1980 mortgage rates fell below 16%, so insurer closes position on April 20 by purchasing 217 contracts for 75-22. A weekly summary of this transaction is shown in Table 2-2.

At the end of March 1981 NHA rates again rose to 16% level. MRI insurer therefore on March 30, 1981 sold 217 March 1982 futures constracts for prevailing price of 66-26. From March 1981 until contract maturity mortgage rates remained above 16%, so insurer stayed in hedge until maturity. The position was closed on March 12, 1982 by purchasing 217 contracts for that day's price fo 61-13. Table 2-3 gives a monthly summary of this transaction. The net gain on these two futures hedges that is available to meet MRI renewal claims would have been $1,627,500 (U.S.) less transaction costs of about $26,700 (U.S.).

II. Hedging Strategy

The Canadian MRI hedger attempting to manage interest rate risk through the futures markets has basically three decisions. First, which market to place the hedge -- Canadian or U.S. futures markets? Second, which instrument to choose among those offered in the selected market -- Treasury bills, bonds, GNMAs, etc.? And, third, which delivery month to select for the hedge among those available for the desired instrument -- near or distant futures contracts? The first decision requires an analysis of both the liquidity of the futures markets in the two countries and the existing evidence on the potential effectiveness of hedges based on spot positions in Canadian mortgages. The results of tests of hedging effectiveness also assist in addressing the second question on instrument selection, along with an understanding of the importance of instrument relationships in a cross-hedge. The final decision on contract maturity is contingent on both the issues of liquidity and effectiveness, as well as a knowledge of basis relationships in a futures hedge.

Liquidity

An important consideration in the formation of a hedging strategy is the absolute and comparative liquidity of the existing Canadian and U.S. futures markets. The greater the volume of trading ("depth" of the market) and the number of outstanding contracts ("breath" of the market), the more liquid the market and the greater the likelihood that it can absorb large hedging positions without significant impacts on market prices. Depth is determined by the total number of futures contracts traded (purchases or sales) during a given time period. Breath can be measured as the amount of "open interest", the number of futures contracts at a given time which have not yet been offset by opposite futures transactions nor fulfilled by delivery.

Figures 2-1 through 2-3 show the levels of daily sales volume and open interest in the Canadian Treasury bill and bond futures contracts offered on the Toronto-Montreal Exchange from September, 1980 through February, 1982.[2] While trading volume in Treasury bill futures has not substantially grown since the opening of the market, transactions in Treasury bond futures have increased from about 25 contracts per day to the level of 120 trades ($12 million in instruments) each day. In addition, open interest in Treasury bonds has now reached a total of over 2,000 outstanding contracts. The greatest recent growth of this trading has been in contracts maturing in 3-6 and 6-9 months, both contracts having open interest at the 700 level in February, 1982.

Comparable data for U.S. futures markets operated by the Chicago Board of Trade and Mercantile Exchanges with contracts in GNMA, U.S. Treasury bond and Canadian dollar futures are presented in Figures 2-4 through 2-7. For the U.S. Treasury bond contracts, the past year has been a period of tremendous growth. Daily trading levels in these futures contracts rose from 25,000 transactions in September, 1980 to over 75,000 contracts ($7.5 billion in instruments) at the start of 1982. Open interest is in the 200,000-300,000 contract range with active Treasury bond trading extending to the 24-27 month maturity. While the activity in the GNMA futures is presently at a lower level than Treasury bonds, it is nevertheless still significant with 10,000 GNMA transactions per day and an open interest of approximately 75,000 contracts across all futures maturities. The least liquid of the three U.S. futures instruments is the Canadian dollar contract. Daily sales volume for these futures in 1982 is at the 2,000 contract level with most of the open interest in the nearby contract.

In comparing the Canadian and U.S. futures markets in terms of relative liquidity, it is clear that at the present time the depth and breath of the trading in U.S. futures contracts far exceeds the levels of activity in the Canadian markets. While the Canadian markets are young and still growing, the existing liquidity in these contracts limits Canadian MRI insurers to comparatively small futures positions (e.g., million dollar Canadian Treasury bond hedges) with hedge terms under one year. The greater size of the U.S. Treasury bond and GNMA markets means that these traders could acquire quite large U.S. futures positions (e.g., billion dollar U.S. Treasury bond contracts) without either seriously affecting market prices or the fear of being unable to offset the position in the future. Additionally, the wider maturity range of the U.S. futures with active trading to the 24-27 month contracts would allow Canadian participants to hedge positions over longer terms. A potential concern to Canadians in U.S. futures trading, however, is the lower level of activity in Canadian dollar contracts. If currency futures positions are necessary for effective interest rate hedging from Canadian mortgage markets (one of the topics considered in the next two sections), there are also contraints for insurers on the absolute magnitude of their futures positions in U.S. markets.

Instrument and Basis Relationships

In a futures hedge the trader relies on the existance of a close relationship between the values of the spot position and the value of the futures position. Since Canadian residential mortgages are not actually traded in any existing futures market, an MRI insurer must cross-hedge, utilize the available futures markets to hedge against the interest rate risk of spot positions in Canadian mortgages. For any type of cross-hedge, the trader must recognize two components to the spot/futures link: (1) the relationship between the spot prices of the instrument being hedged and the spot prices of the instrument represented by the futures contract; and, (2) the relationship between the spot prices and the futures prices of the instrument represented by the futures contract. The first component, identified as the instrument relationship, only exists for cross-hedges, while the second, the basis relationship, is a concern in cross and straight hedges (the hedging of a spot position in a futures instrument).

Since cross-hedgers are taking positions in instruments not actually traded in the futures market, the movements of the yields and prices of the spot instrument and a futures instrument may not be perfectly correlated. Unlike a straight hedge, a cross-hedge is affected by demand and supply conditions in two different financial markets and by the comparative responsiveness of instruments' prices to yield movements. One aspect of this instrument relationship is the impact that a change in the general level of interest rates has on the changes in the spot prices of different financial instruments. For instance, a .01% change in a market yields would cause a $25 change in the value of a Canadian Treasury bill futures contract. However, the value of a Canadian mortgage will change approximately $85 for every .01% change in yield.[3] Therefore, to effectively hedge a $1 million position in Canadian mortgages, it would be necessary to use three or four Treasury bill contracts in order to establish dollar-equivalent hedging. The idea is to structure hedges to insure equivalent dollar movements of the spot and futures positions for given changes in interest rates.

Other more important aspects for Canadian hedgers in U.S. futures markets are the strength of the relationship between Canadian and U.S. interest rates and exchange risk. For effective cross-hedging with U.S. futures, Canadian and U.S. interest rates must generally move together. If the currency exchange rate between the countries is basically a function of interest rate differentials, uncovered exchange rate movements could also decrease the hedging effectiveness of U.S. futures for Canadian traders. As an example assume that in a short hedge U.S. interest rates do not rise as much as Canadian rates. With constant exchange rates the gain denominated in U.S. dollars on the futures position would then be less than the spot loss in terms of Canadian dollars. With exchange rates that are highly interest elastic, the higher Canadian interest rates would cause decreases in the exchange value of U.S. dollars and a further reduction in the U.S. futures gain when converted to Canadian dollars.

The Canadian trader with a U.S. futures position can protect against adverse U.S./Canadian exchange rate movements through an additional hedge in the Canadian dollar futures market. In the case of the Canadian short-hedger in U.S. financial futures, a long position in Canadian dollars in the currency futures market could be utilized to hedge exchange risk. Any reduction in the exchange value of the financial futures gain due to declining values of U.S. dollars could then be offset by gains on the currency position. Thus for the Canadian MRI insurer in U.S. financial futures, a multiple-positions strategy which includes a currency futures position could potentially improve hedging effectiveness if interest-rate differentials and exchange rates between the two countries did not remain constant during the term of the hedge.

With respect to the second relationship, the basis is defined as the difference at a given time between the futures and spot prices of a commodity. The basis at period t=0 is

$$\beta_0^m = p_0^f - p_0^s \qquad (1)$$

where p_0^f = price in t=0 of futures contract maturing in t=m and p_0^s = spot price in t=0. If a trader buys a security in the spot market in t=0 and then sells a futures contract in the same security for delivery in t=m, he eliminates price risk and has a known return over the remaining life of the futures contract determined by "carry", the differenc[illegible]tween short-term financing costs of acquiring the security (i_0) and the [illegible]pon yield of the security (y_0). Arbitrage within the spot and futures markets forces the basis for a financial instrument in t=0 to be

$$p_0^f - p_0^s = (i_0 - y_0)p_0^s \qquad (2)$$

with i_0 and y_0 in rates applicable to the length of time from t=0 to t=m, the remaining term of the futures contract.

With positive carry ($y_0 > i_0$), the spot price of the instrument in t=0 is greater than the futures price in t=0 for a contract expiring in t=m. With negative carry ($y_0 < i_0$), corresponding spot prices are lower than futures prices. These basis relationships are demonstrated graphically in Figure 2-8.

Changes in the basis can result in net gains or losses on any spot/futures hedge where the term of the spot position is not perfectly matched to the outstanding maturity of a futures contract. A widening ("strengthening") of the basis ($\beta_1^m > \beta_0^m$) can mean for short hedgers a net loss on their futures hedge. If both interest rates and the basis increase, then futures prices have fallen by an amount less than the drop in spot prices and the loss to the trader on the spot position is greater than the gain on the short futures position. Conversely, any widening of the basis results in a net gain for long hedgers on their spot/futures positions. A narrowing ("weakening") of the basis can cause a net gain for the short hedger and a net loss for the long hedger.

Basis changes occur due to the convergence of futures/spot price spreads over time and from shifts in the term structure of interest rates. The narrowing of the basis as the futures contract approaches maturity results from a decline in the amounts of both the security return ($y_0 p_0^s$) and the financing cost ($i_0 p_0^s$). As shown in Figure 2-8, the basis is smaller for nearby as opposed to distant futures contracts. Convergence can work for or against a trader depending on the type of hedge (short or long) and nature of the market (positive or negative carry). For example, in the case of short hedgers, convergence is unfavorable in positive carry markets and an MRI trader could attempt to reduce its effect by placing the hedge in more distant contracts (maturity substantially greater than hedge term) where the rate of convergence is lower. However, with fluctuations in the term structure, positive carry (long-term rates, y_0, greater than short-term rates, i_0) can switch to negative ($y_0 < i_0$) or vice versa leading to further changes in the basis independent of convergence. Unless the trader can establish a perfect hedge (length of the hedge exactly equals the maturity of an outstanding futures contract) or separately hedge term structure shifts, changes in the basis relationships may reduce the effectiveness of a hedge in the futures market by an MRI insurer.

Results of Tests of Hedging Effectiveness

Recent research has been directed at empirically testing the potential for effective hedging in U.S. futures markets by Canadian traders with spot positions in the mortgage market.[4] This study summarizes those results and presents preliminary evidence on the probable effectiveness of the existing Canadian futures markets.

The three U.S. futures markets that have been tested are the GNMA and Treasury bond contracts on the Chicago Board of Trade and the Canadian dollar futures market offered by the Chicago Mercantile Exchange. The weekly changes in futures prices over alternative hedge lengths (2 through 52 weeks) for different futures contracts (nearby through 12-15 months, if available) are independent variables in multiple regressions with spot price changes of Canadian residential mortgages as the dependent variable.[5] In regressions containing GNMA and/or Canadian $ contracts, the observations are drawn from the period of January, 1976 to December, 1980; however, in runs including Treasury bond contracts, the sample is limited by the 1977 opening of this market to a sampling period of August, 1977 through December, 1980. While regressions are performed with all of the available futures maturities, in all cases the futures contract maturing closest to the end of the hedge term had the most effective hedging results and only those results are presented in this study.

Table 2-4 shows the regression results for Canadian mortgages with interest rate hedges in U.S. futures markets but without including an exchange rate hedge. The greater instrument risk in a cross-border hedge reduces the level of hedging effectiveness for Canadian traders. The R^2s for the shorter-term hedges (2-week through 12-week) are quite low, meaning the tested U.S. futures contracts without a currency hedge are of little assistance in cross-hedging Canadian mortgage positions of such durations.[6] Yet in the longer 26-week and 52-week hedges, the R^2s are significantly higher (reaching .656 in the 52-week GNMA run) and the strength of the relationship between Canadian mortgages and GNMA futures is sufficient to offer worthwhile longer-term hedging opportunities by MRI insurers even in the absence of an exchange rate hedge.

The regression results for the same hedges found in Table 2-4 but with an additional position in a Canadian dollar futures contract are presented in Table 2-5. Since prior to July, 1979 there was a low level of trading activity in Canadian dollar futures beyond the 6-9 month contract, 52-week hedges with currency positions were not tested. In the tested hedges when an exchange rate position is added to the financial futures positions, there is a further improvement in hedging performance for Canadian traders, especially in the 12-week and beyond hedges. Yet, the increase in the R^2s is not substantial and these results suggest that in the hedge maturities listed currency futures positions are not absolutely required to obtain effective hedging in U.S. markets.

The regression coefficients of the currency futures positions generally exhibit the anticipated negative signs, the exception being the 2 and 4-week hedges where the currency coefficients are unstable. The results suggest that Canadian/U.S. exchange rate movements in the currency futures market are responsive over twelve or more weeks to shifts of the interest-rate differentials between the two countries. The coefficients further show that the optimal hedge ratio for Canadian mortgage traders in the two financial futures is substantially less than 1 over all hedge terms (every GNMA and Treasury bond coefficient is significantly different form 1 at the 5% level). For the currency future the optimal ratio tends to be around 2, indicating that Canadian dollar futures movements produced by a given change in interest rates are on average only about one-half the size of movements of Canadian mortgage values. Together these results suggest that for Canadian insurers their optimal futures exposures in terms of dollar equivalency are only relatively small positions in GNMA or Treasury bond futures combined with comparatively large positions in Canadian dollar futures.

Comparable tests of the hedging effectiveness of Canadian futures markets are presently prohibited by the lack of a sufficient futures price series due to their recent opening. However, for the purposes of this study, tests are performed to evaluate the strength of the instrument relationship between Canadian mortgages and Canadian Treasury bills and bonds. Table 2-6 gives the results of regressions with spot price changes (rather than changes of futures prices) as the independent variables.

The high R^2s for hedges of 12 weeks and beyond suggests the potential for highly effective hedges in the Canadian futures market. The lower instrument risk in Canadian markets increases the levels of hedging performance. Of course, these results are biased upward by the absence of basis changes in the data. It should also be noted that the spot relationships are strongest between Canadian mortgages and Treasury bills, rather than Treasury bonds. As discussed earlier, the minimal liquidity in the Canadian Treasury bill futures market presently inhibits the usefulness of this contract for large hedging positions by MRI insurers.

Implications of Risk Management

The results of these tests of hedging effectiveness just described indicate that a substantial portion of the interest rate risk in an MRI contract can potentially be offset in the existing futures markets. To the degree that this risk can be hedged, the risk compensation factor in the MRI premium can be lowered below the level necessary if all the risk were absorbed by the insurer. While the evidence presented in this study should not be viewed as the definitive measures of hedging effectiveness, especially in the case of the Canadian futures markets, these R^2s are the best estimates available at the present time of the ranges of the potential reductions in insurance premiums possible through futures hedging.

For MRI policies with terms of 3-6 months such as with commitment insurance, these results suggest that MRI risk factors could be reduced by approximately 20-30% through hedging in U.S. futures markets and around 30-50% in Canadian futures markets. For MRI contracts having a one-year term (commitment and renewal), the R^2s indicate possible premium reductions of 50-60% in U.S. markets and 50-75% in Canadian markets. While futures hedges beyond one year have yet to be tested (and are not available in Canadian futures markets), the existing tests do show that hedging effectiveness tends to improve as the hedge maturity lengthens. Therefore, it is likely that the one-year discounts would be conservative estimates of the possible premium reductions in MRI policies longer than one year.

These estimates of potential premium reductions must, however, be cautiously evaluated in the design of an MRI premium structure. First, as mentioned earlier, futures markets in Canada as well as the Canadian dollar futures market in the U.S. are relatively small and lack sufficient liquidity to absorb the large positions sought by an insurer attempting to shift all the risk in MRI policies to these markets. Second, the available contract maturities in these futures markets are presently up to about one year and in the more liquid U.S. GNMA and Treasury bond markets existing futures contracts do not extend beyond three years. To hedge MRI positions having terms longer than the available contracts (e.g., renewal insurance on a five-year rollover mortgage) would require dynamic hedging on the part of the insurer -- rolling over into a new futures contract as an existing one approaches its delivery date. While such a hedging strategy could still be effective, it should be noted that dynamic hedging has not yet been formally tested in any existing research. Third, if the MRI premium models do not directly price catastrophic risk and it cannot be totally hedge in the futures markets, the insurer may still want to require an adjustment in this risk factor in the MRI premium to build a reserve as protection against this peril.

Finally, as previously discussed, an MRI insurer has a one-sided risk position requiring a more active hedging strategy to protect against downside losses in the futures market. Similar to the catastrophic risk factor, the insurer may want to utilize the insurance premiums to create additional reserves to cover potential trading losses in short futures positions if interest rates unexpectedly fall. For example, adding 1/10 of 1% to the MRI premium (e.g., raising it from .5% to .6% of the insured loan balance) is sufficient to create a reserve to cover downside losses in futures trading of up to almost one-eighth a point per futures contract (i.e., 4/32 per $100,000 contract).

III. Option Markets

An option contract as written on the options exchanges gives the purchaser for the price of the option the right to buy (call option) or sell (put option) a specified amount of an asset at a fixed price (the exercise or striking price) for a specific length of time. The owner of the option can exercise only at maturity (European option) or at any time up to the maturity date (American option). Similar to the futures markets, the option exchange acts as an intermediary and guarantor of all transactions.

A financial institution could utilize call and put options in mortgage or mortgage-like instruments to protect against the risks created by volatile interest rates. For example, assume a trader wishes to hedge a spot financial position from the impact of rising market rates. By selling a call option (or buying a put option) in a financial instrument on an options exchange, an increase in interest rates results in a falling market value of a call option (or a rising value of the put option) and a gain for the short call (long put) trader. When the option position is closed through an offsetting exchange transaction, the gain on the options trade hedges the spot losses created by the rising market rates.

An example of an options contract in mortgages that has been available for many years in the U.S. is the purchase commitment offered by the Federal National Mortgage Assciation (FNMA). The FNMA commitment gives the purchaser (mortgage lender) for a fee the right to sell a set quantity of mortgages to FNMA at a fixed price at any point during a four-month period. Thus, the commitment is essentially an American put. If interest rates rise during the commitment period, the lender/option buyer can exercise the commitment and is thereby protected from drops in the market value of the mortgages. Conversely, if interest rates fall, the lender does not sell the mortgages to FNMA and its only loss is the commitment fee.

Recently in the U.S. the Chicago Board Options Exchange announced plans to offer contracts in GNMA securities. With the introduction of this option market, traders from the mortgate market would be able to acquire both put and call GNMA options and hedge against rising and falling market interest rates over a range of exercise periods. An important difference between interest-rate hedging in futures and options markets is that with options, the hedge is not symmetric. The downside loss is limited to the option price. For example, in a short futures hedge, the gain or loss on the futures position is unlimited if interest rates fluctuate during the hedge. With a short position in a call option (or a long position in a put option), the loss on the option if rates fall is restricted to the cost of the option, while if interest rates rise the option gain is unlimited.

This lack of symmetry in an option hedge is an advantage for an MRI insurer attempting to offset interest rate risk. Utilizing the futures market to hedge this risk is difficult with MRI insurance since the insurer's spot position is one-sided. There is no gain if interest rates fall to make up for the losses in short futures positions. However, the limited downside loss in an option position corresponds well to the spot position of the MRI insurer and the options market could be a potentially quite useful mechanism for hedging risk in mortgage rate insurance.

CHAPTER 2

FOOTNOTES

1. Data taken fom Canada Mortgage and Housing Corporation, Canadian Housing Statistics (various issues) and from a weekly survey of mortgage interest rates provided by CMHC.

2. The daily levels of sales volume and open interest are derived on a monthly basis by taking the average of the Wednesdays' tradings in each month.

3. This mortgage calculation assumes a one-year term with a semi-annually compounded interest rate and a 25-year amortization period.

4. G.W. Gau and M.A. Goldberg, "Cross-Hedging among Mortgage and Futures Mortgages," Urban Land Economics Working Paper, University of British Columbia, 1981.

5. To derive the mortgage price changes, calculations are made at the beginning of the hedge of the market values of $100 mortgages with the assumptions of a five-year term, 25-year amortization, and the semi-annual compounding of interest. The market values of these mortgages at the conclusion of the hedge are then determined from the original payment flows and the interest rates applicable to the ending week of the hedge. The source of these weekly mortgage interest rates is the Financial Post.

6. It should be noted that measurement errors do bias the R^2s in these tests. Since the mortgage rate series utilized are judgments of the typical conventional mortgage rate offered in a given week, the weekly variations are in changes of not less than one-quarter of a point. This lumpiness in the data is a partial explanation for the low R^2s in the shorter-term hedges.

HEDGING ANALYSIS

TABLE 2-1
US GNMA FUTURES (US$)
$37.5 MILLION
OCTOBER 1979 TO JANUARY 1981

CONTRACT:
GNMA MARCH 81

DATE (DD/MM/YY)	7/11/79	5/12/79	2/ 1/80	6/ 2/80	5/ 3/80
PRIOR CLOSING PRICE	78-12	76- 3	81-12	79- 2	72-19
SETTLEMENT PRICE	76- 3	81-12	79- 2	72-19	69- 6
TICKS PER CONTRACT	-73	169	-74	-207	-109
NUMBER OF CONTRACTS	-75	-75	-75	-75	-75
GROSS PROFIT (LOSS)	$ 855469	$ -1980469	$ 867188	$ 2425781	$ 1277344

MARGIN CALLS:

	7/11/79	5/12/79	2/ 1/80	6/ 2/80	5/ 3/80
INITIAL MARGIN	$ 150000	$ 150000	$ 150000	$ 150000	$ 150000
CURRENT EQUITY	150000	-1830469	150000	150000	150000
MAINTENANCE MARGIN	112500	112500	112500	112500	112500
MARGIN CALL		$ 1980469			
AMOUNT ADDED TO (SUBTRACTED FROM) CUSTOMER ACCOUNT	$ 1005469	$ -1980469	$ 867188	$ 2425781	$ 1277344
ACCOUNT BALANCE	$ 1005469	$ -975000	$ -107812	$ 2317969	$ 3595313
AMOUNT IN EXCESS OF INITIAL MARGIN	$ 855469	$ -1125000	$ -257812	$ 2167969	$ 3445313

HEDGING ANALYSIS

TABLE 2-1
US GNMA FUTURES (US$)
$37.5 MILLION
OCTOBER 1979 TO JANUARY 1981

CONTRACT:
GNMA MARCH 81

DATE (DD/MM/YY)	2/ 4/80	7/ 5/80	4/ 6/80	2/ 7/80	6/ 8/80
PRIOR CLOSING PRICE	69- 6	69- 0	80-10	78-19	76-28
SETTLEMENT PRICE	69- 0	80-10	78-19	76-28	73-29
TICKS PER CONTRACT	-6	362	-55	-55	-95
NUMBER OF CONTRACTS	-75	-75	-75	-75	-75
GROSS PROFIT (LOSS)	$ 70313	$ -4242187	$ 644531	$ 644531	$ 1113281
MARGIN CALLS:					
INITIAL MARGIN	$ 150000	$ 150000	$ 150000	$ 150000	$ 150000
CURRENT EQUITY	150000	-4092187	150000	150000	150000
MAINTENANCE MARGIN	112500	112500	112500	112500	112500
MARGIN CALL		$ 4242188			
AMOUNT ADDED TO (SUBTRACTED FROM) CUSTOMER ACCOUNT	$ 70313	$ -4242187	$ 644531	$ 644531	$ 1113281
ACCOUNT BALANCE	$ 3665625	$ -576562	$ 67969	$ 712500	$ 1625781
AMOUNT IN EXCESS OF INITIAL MARGIN	$ 3515625	$ -726562	$ -82031	$ 562500	$ 1625781

HEDGING ANALYSIS

TABLE 2-1
US GNMA FUTURES (US$)
$37.5 MILLION
OCTOBER 1979 TO JANUARY 1981

CONTRACT:
GNMA MARCH 81

DATE (DD/MM/YY)	3/ 9/80	1/10/80	5/11/80	3/12/80	7/ 1/81
PRIOR CLOSING PRICE	73-29	73- 2	69-30	67- 2	68-19
SETTLEMENT PRICE	73- 2	69-30	67- 2	68-19	71-13
TICKS PER CONTRACT	-27	-100	-92	49	90
NUMBER OF CONTRACTS	-75	-75	-75	-75	-75
GROSS PROFIT (LOSS)	$ 316406	$ 1171875	$ 1078125	$ -574219	$ -1054687

MARGIN CALLS:

	3/ 9/80	1/10/80	5/11/80	3/12/80	7/ 1/81
INITIAL MARGIN	$ 150000	$ 150000	$ 150000	$ 150000	$ 150000
CURRENT EQUITY	150000	150000	150000	-424219	-904687
MAINTENANCE MARGIN	112500	112500	112500	112500	112500
MARGIN CALL				$ 574219	$ 1054688
AMOUNT ADDED TO (SUBTRACTED FROM) CUSTOMER ACCOUNT	$ 316406	$ 1171875	$ 1078125	$ -574219	$ -1054687
ACCOUNT BALANCE	$ 2142188	$ 3314063	$ 4392188	$ 3817969	$ 2763281
AMOUNT IN EXCESS OF INITIAL MARGIN	$ 1992188	$ 3164063	$ 4242188	$ 3667969	$ 2613281

HEDGING ANALYSIS

TABLE 2-2
US GNMA FUTURES (US$)
$108.5 MILLION
APRIL 1980

CONTRACT:
GNMA MARCH 1982

DATE (DD/MM/YY)	16/ 4/80	23/ 4/80	30/ 4/80
PRIOR CLOSING PRICE	71-25	76- 0	75- 4
SETTLEMENT PRICE	76- 0	75- 4	75-22
TICKS PER CONTRACT	135	-28	18
NUMBER OF CONTRACTS	-217	-217	-217
GROSS PROFIT (LOSS)	$ -4577344	$ 949375	$ -610312

MARGIN CALLS:

INITIAL MARGIN	$ 434000	$ 434000	$ 434000
CURRENT EQUITY	-4143344	434000	-176312
MAINTENANCE MARGIN	325500	325500	325500
MARGIN CALL	$ 4577344		$ 610313
AMOUNT ADDED TO (SUBTRACTED FROM) CUSTOMER ACCOUNT	$ -4143344	$ 949375	$ -610312
ACCOUNT BALANCE	$ -4143344	$ -3193969	$ -3804281
AMOUNT IN EXCESS OF INITIAL MARGIN	$ -4577344	$ -3627969	$ -4238281

HEDGING ANALYSIS

TABLE 2-3
US GNMA FUTURES (US$)
$108.5 MILLION
MARCH 1981 TO MARCH 1982

CONTRACT:
GNMA MARCH 1982

DATE (DD/MM/YY)	30/ 4/81	29/ 5/81	30/ 6/81	30/ 7/81	31/ 8/81
PRIOR CLOSING PRICE	66-26	62-28	65-13	63- 1	60-30
SETTLEMENT PRICE	62-28	65-13	63- 1	60-30	57- 3
TICKS PER CONTRACT	-126	81	-76	-67	-123
NUMBER OF CONTRACTS	-217	-217	-217	-217	-217
GROSS PROFIT (LOSS)	$ 4272188	$ -2746406	$ 2576875	$ 2271719	$ 4170469

MARGIN CALLS:

	30/ 4/81	29/ 5/81	30/ 6/81	30/ 7/81	31/ 8/81
INITIAL MARGIN	$ 434000	$ 434000	$ 434000	$ 434000	$ 434000
CURRENT EQUITY	434000	-2312406	434000	434000	434000
MAINTENANCE MARGIN	325500	325500	325500	325500	325500
MARGIN CALL		$ 2746406			
AMOUNT ADDED TO (SUBTRACTED FROM) CUSTOMER ACCOUNT	$ 4706188	$ -2746406	$ 2576875	$ 2271719	$ 4170469
ACCOUNT BALANCE	$ 4706188	$ 1959781	$ 4536656	$ 6808375	$ 10978844
AMOUNT IN EXCESS OF INITIAL MARGIN	$ 4272188	$ 1525781	$ 4102656	$ 6374375	$ 10544844

HEDGING ANALYSIS

TABLE 2-3
US GNMA FUTURES (US$)
$108.5 MILLION
MARCH 1981 TO MARCH 1982

CONTRACT:
GNMA MARCH 1982

DATE (DD/MM/YY)	30/ 9/81	30/10/81	30/11/81	31/12/81	29/ 1/82
PRIOR CLOSING PRICE	57- 3	55-12	59-18	64-25	61- 2
SETTLEMENT PRICE	55-12	59-18	64-25	61- 2	60-11
TICKS PER CONTRACT	-55	134	167	-119	-22
NUMBER OF CONTRACTS	-217	-217	-217	-217	-217
GROSS PROFIT (LOSS)	$ 1864844	$ -4543437	$ -5662344	$ 4034844	$ 745938
MARGIN CALLS:					
INITIAL MARGIN	$ 434000	$ 434000	$ 434000	$ 434000	$ 434000
CURRENT EQUITY	434000	-4109437	-5228344	434000	434000
MAINTENANCE MARGIN	325500	325500	325500	325500	325500
MARGIN CALL		$ 4543438	$ 5662344		
AMOUNT ADDED TO (SUBTRACTED FROM) CUSTOMER ACCOUNT	$ 1864844	$ -4543437	$ -5662344	$ 4034844	$ 745938
ACCOUNT BALANCE	$ 12843688	$ 8300250	$ 2637906	$ 6672750	$ 7418688
AMOUNT IN EXCESS OF INITIAL MARGIN	$ 12409688	$ 7866250	$ 2203906	$ 6238750	$ 6984688

HEDGING ANALYSIS

TABLE 2-3
US GNMA FUTURES (US$)
$108.5 MILLION
MARCH 1981 TO MARCH 1982

CONTRACT:
GNMA MARCH 1982

DATE (DD/MM/YY)	26/ 2/82	12/ 3/82
PRIOR CLOSING PRICE	60-12	60-25
SETTLEMENT PRICE	60-25	61-13
TICKS PER CONTRACT	13	20
NUMBER OF CONTRACTS	-217	-217
GROSS PROFIT (LOSS)	$ -440781	$ -678125
MARGIN CALLS:		
INITIAL MARGIN	$ 434000	$ 434000
CURRENT EQUITY	-6781	-244125
MAINTENANCE MARGIN	325500	325500
MARGIN CALL	$ 440781	$ 678125
AMOUNT ADDED TO (SUBTRACTED FROM) CUSTOMER ACCOUNT	$ -440781	$ -678125
ACCOUNT BALANCE	$ 6977906	$ 6299781
AMOUNT IN EXCESS OF INITIAL MARGIN	$ 6543906	$ 5865781

TABLE 2-4
Canadian Mortgages/U.S. Futures
(Without Exchange Hedge)

Hedge	Futures Contracts	Constant	GNMA Coefficient	Treasury Bond Coefficient	R^2
2	Nearby	-.125	.082		.012
Weeks		(.103)	(.052)		
		-.245		.044	.005
		(.140)		(.053)	
		-.254	.131	-.059	.008
		(.143)	(.214)	(.176)	
4	Nearby	-.165	.240		.079
Weeks		(.191)	(.064)		
		-.272		.226	.089
		(.259)		(.068)	
		-.271	.041	.193	.089
		(.274)	(.275)	(.232)	
12	3-6	-.238	.245		.093
Weeks	Months	(.262)	(.051)		
		-.664		.211	.085
		(.385)		(.057)	
		-.661	.044	.173	.085
		(.387)	(.282)	(.251)	
26	6-9	-.457	.372		.298
Weeks	Months	(.254)	(.039)		
		-1.272		.263	.183
		(.399)		(.048)	
		-1.260	.073	.201	.184
		(.402)	(.226)	(.196)	
52	12-15	-.951	.487		.656
Weeks	months	(.250)	(.026)		
		-3.262		.269	.306
		(.457)		(.038)	
		-3.318	.293	.002	.323
		(.455)	(.176)	(.165)	

Figures in parentheses under estimated constant and coefficients are standard errors.

All coefficients are significantly different from 1 at .05 level (test not applied to constant).

Source: Gau, G.W. and M.A. Goldberg. 1981. "Cross-Hedging Among Mortgage and Futures Markets". Urban Land Economics Working Paper, University of British Columbia.

TABLE 2-5
Canadian Mortgages/U.S. Futures
(With Exchange Hedge)

Hedge	Futures Contracts	Constant	GNMA Coefficient	Treasury Bond Coefficient	Canadian $ Coefficient	R^2
2	Nearby	-.089	.086		.199*	.016
Weeks		(.112)	(.055)		(.318)	
		-.183		.050	.163*	.008
		(.151)		(.057)	(.368)	
		-.195	.131	-.056	.169*	.010
		(.155)	(.235)	(.197)	(.373)	
4	Nearby	-.151	.259		.577	.093
Weeks		(.251)	(.069)		(.540)	
		-.163		.248	.600	.105
		(.290)		(.075)	(.656)	
		-.163	.055	.204	.598	.105
		(.303)	(.310)	(.266)	(.668)	
12	3-6	-.134	.148		-2.172*	.215
Weeks	Months	(.255)	(.051)		(.376)	
		-.743		.071	-2.728*	.276
		(.346)		(.056)	(.442)	
		-.743	.004	.068	-2.728*	.276
		(.348)	(.253)	(.255)	(.443)	
26	6-9	-.427	.349		-.967	.323
Weeks	Months	(.288)	(.041)		(.316)	
		-1.386		.168	-1.924*	.317
		(.369)		(.048)	(.378)	
		-1.364	.145	.046	-1.942*	.320
		(.371)	(.208)	(.182)	(.380)	

Figures in parentheses under estimated constant and coefficients are standard errors.

* Canadian dollar coefficients which are significantly different from 1 at .05 level. All GNMA and Treasury bond coefficients are significantly different from 1 (test not applied to constant).

Source: Gau, G.W. and M.A. Goldberg. 1981. "Cross-Hedging Among Mortgage and Futures Markets". Urban Land Economics Working Paper, University of British Columbia.

TABLE 2-6

Canadian Mortgages/Canadian Futures Instruments

Hedge	Constant	Canadian Treasury Bill Coefficient	Canadian Treasury Bond Coefficient	R^2
4 Weeks	-.023	5.080		.087
	(.194)	(3.115)		
	.074		-.152	.046
	(.201)		(.130)	
	.039	6.990	-.243	.194
	(.188)	(3.146)	(.128)	
12 Weeks	-.356	10.403		.697
	(.239)	(1.194)		
	.104		.435	.299
	(.355)		(.116)	
	-.355	9.861	.058	.700
	(.242)	(1.505)	(.096)	
26 Weeks	-.884	9.916		.806
	(.300)	(.875)		
	-.407		.608	.542
	(.448)		(.100)	
	-.879	8.500	.145	.820
	(.293)	(1.247)	(.093)	
52 Weeks	-1.542	8.088		.841
	(.398)	(.719)		
	-1.846		.847	.841
	(.409)		(.075)	
	-1.863	4.392	.461	.915
	(.306)	(.988)	(.103)	

Figures in parentheses under estimated constant and coefficients are standard errors.

FIGURE 2-1

Daily Sales Volume
Canadian Treasury Bill and Bond Futures
Toronto/Montreal Exchange

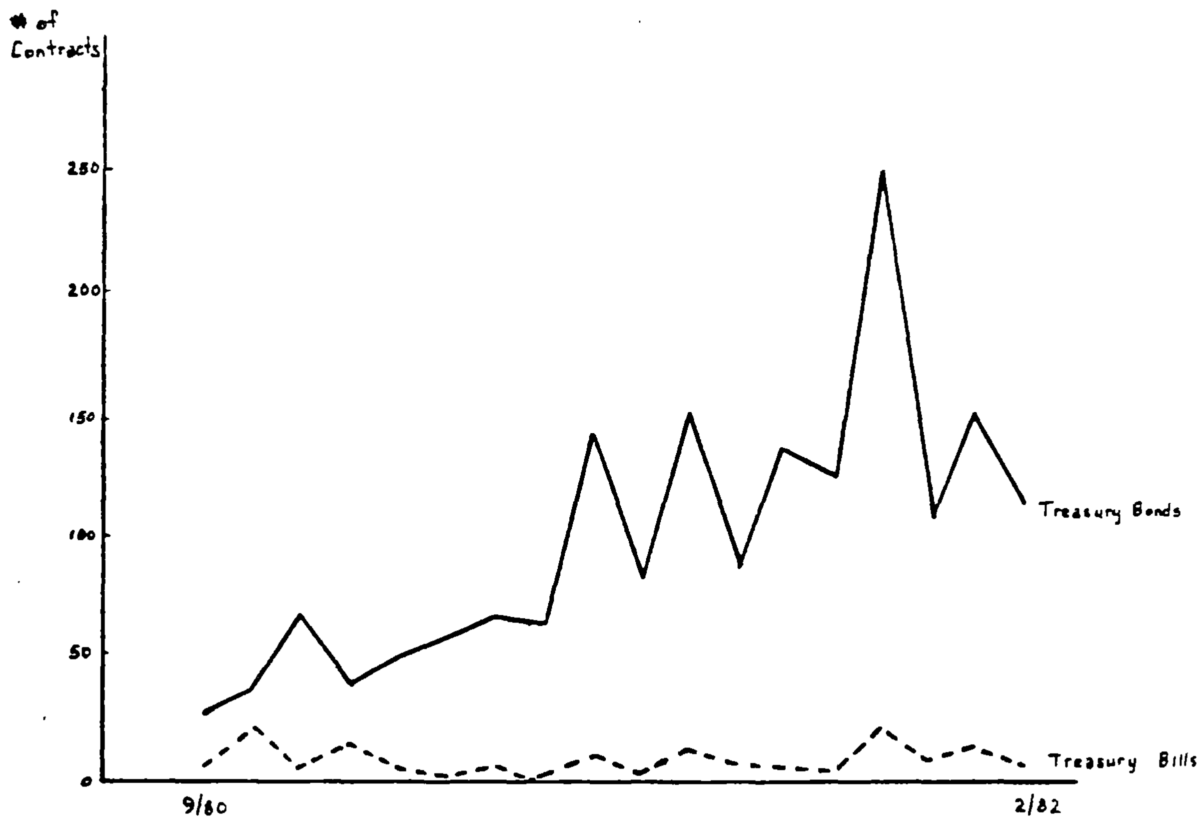


FIGURE 2-2

Daily Open Interest
Canadian Treasury Bill Futures

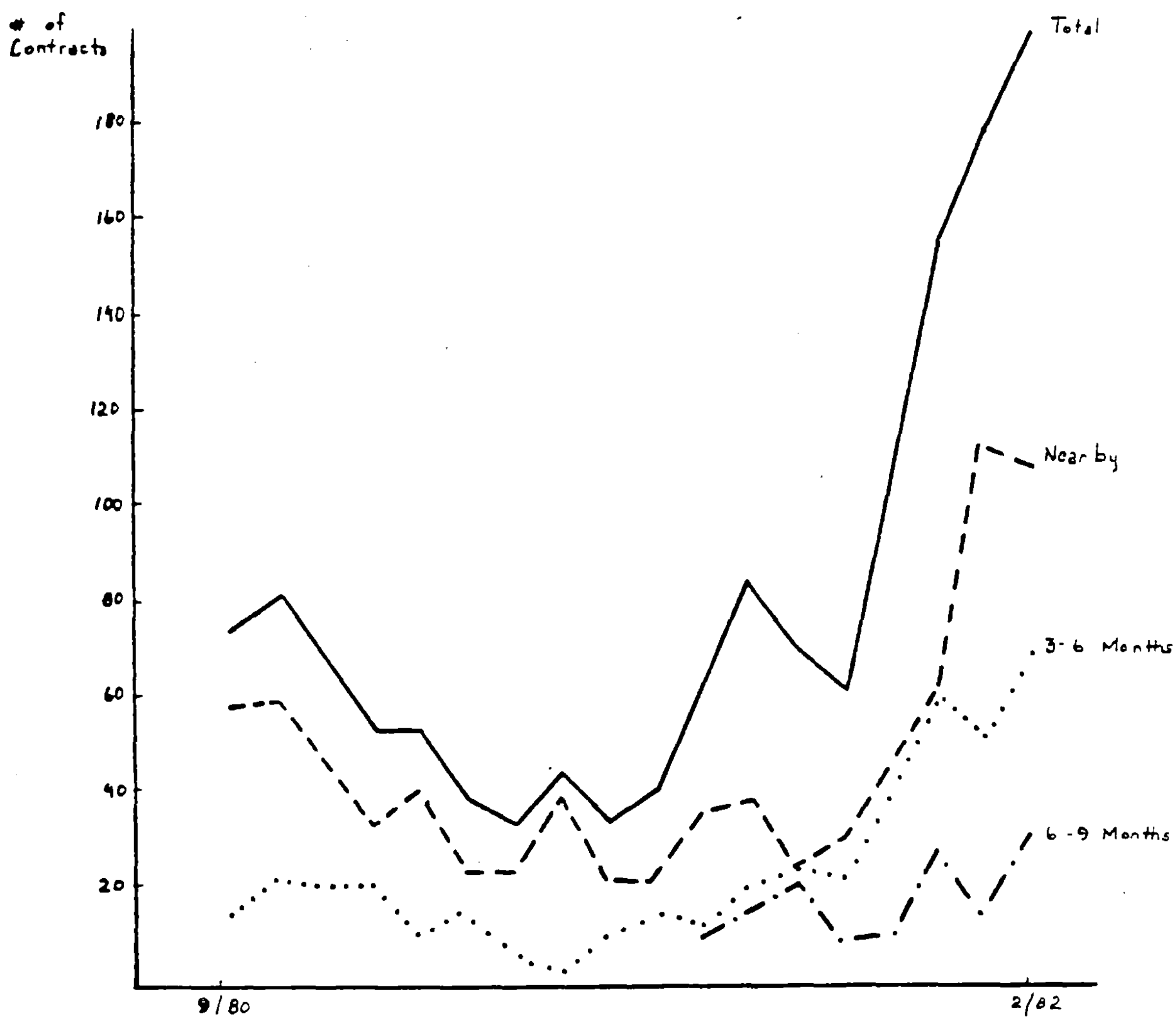


FIGURE 2-3

Daily Open Interest
Canadian Treasury Bond Futures

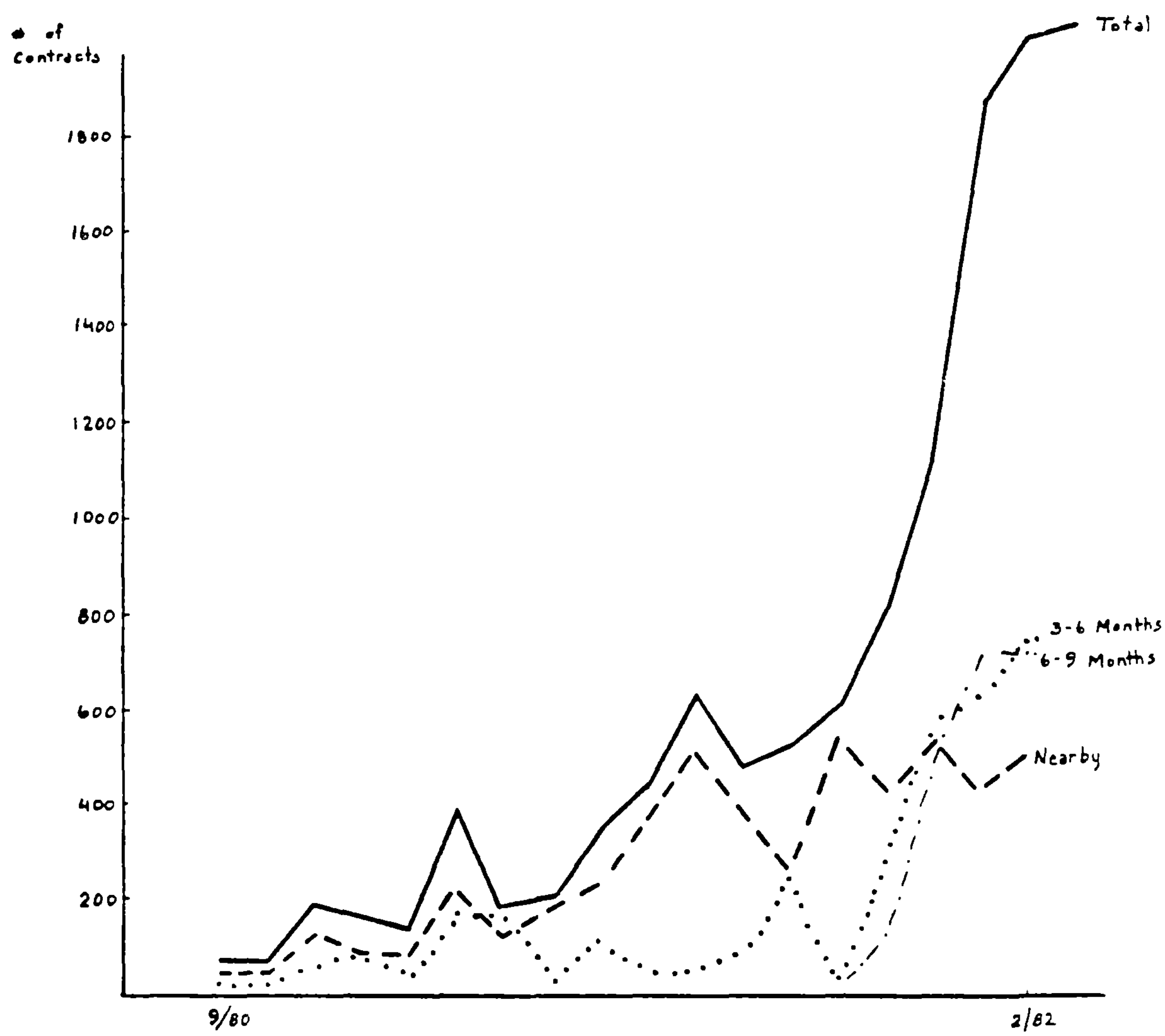


FIGURE 2-4

Daily Sales Volume
U.S. Futures Instruments
Chicago Board of Trade and Mercantile Exchanges

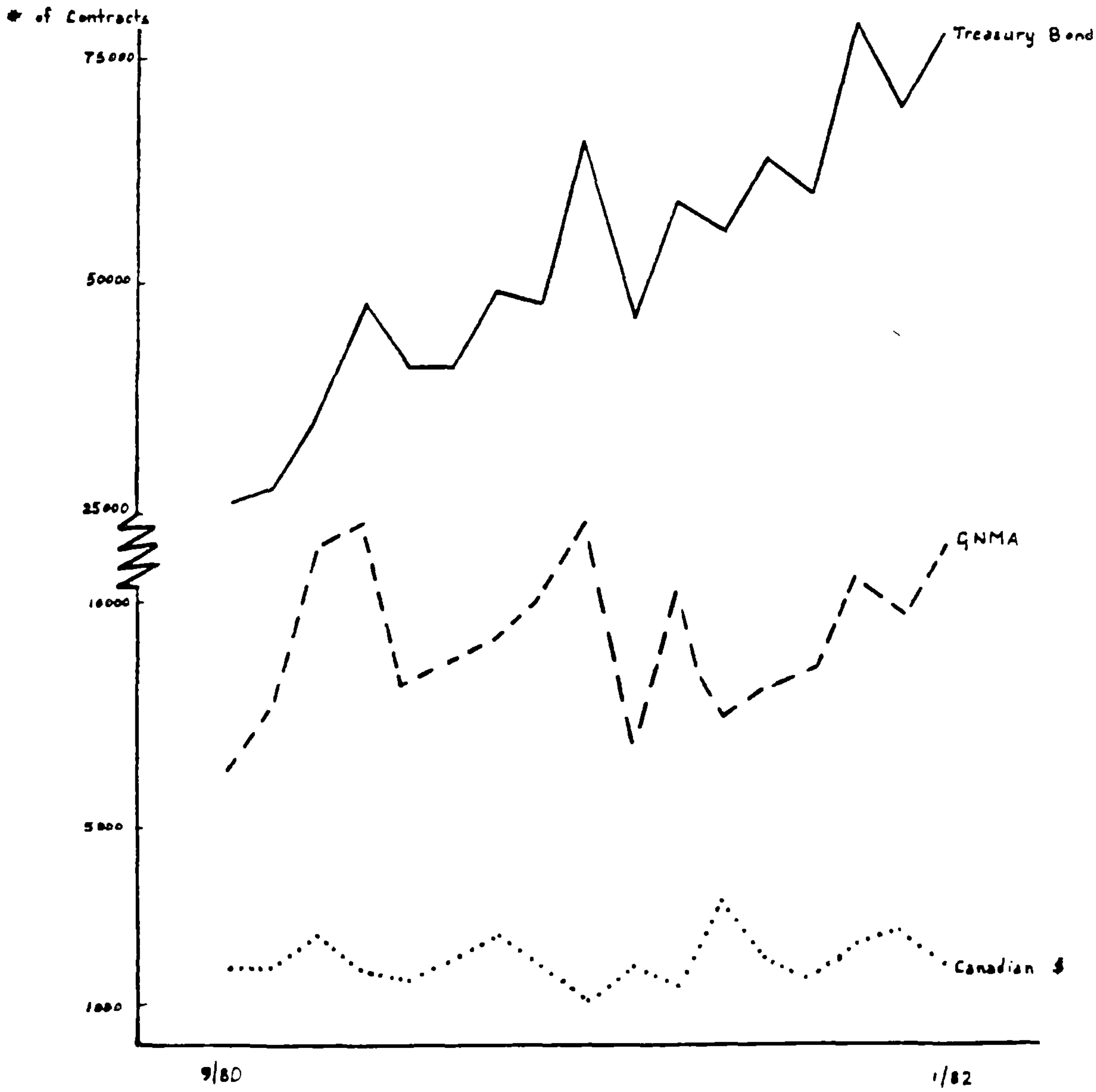


FIGURE 2-5

Daily Open Interest
U.S. GNMA Futures

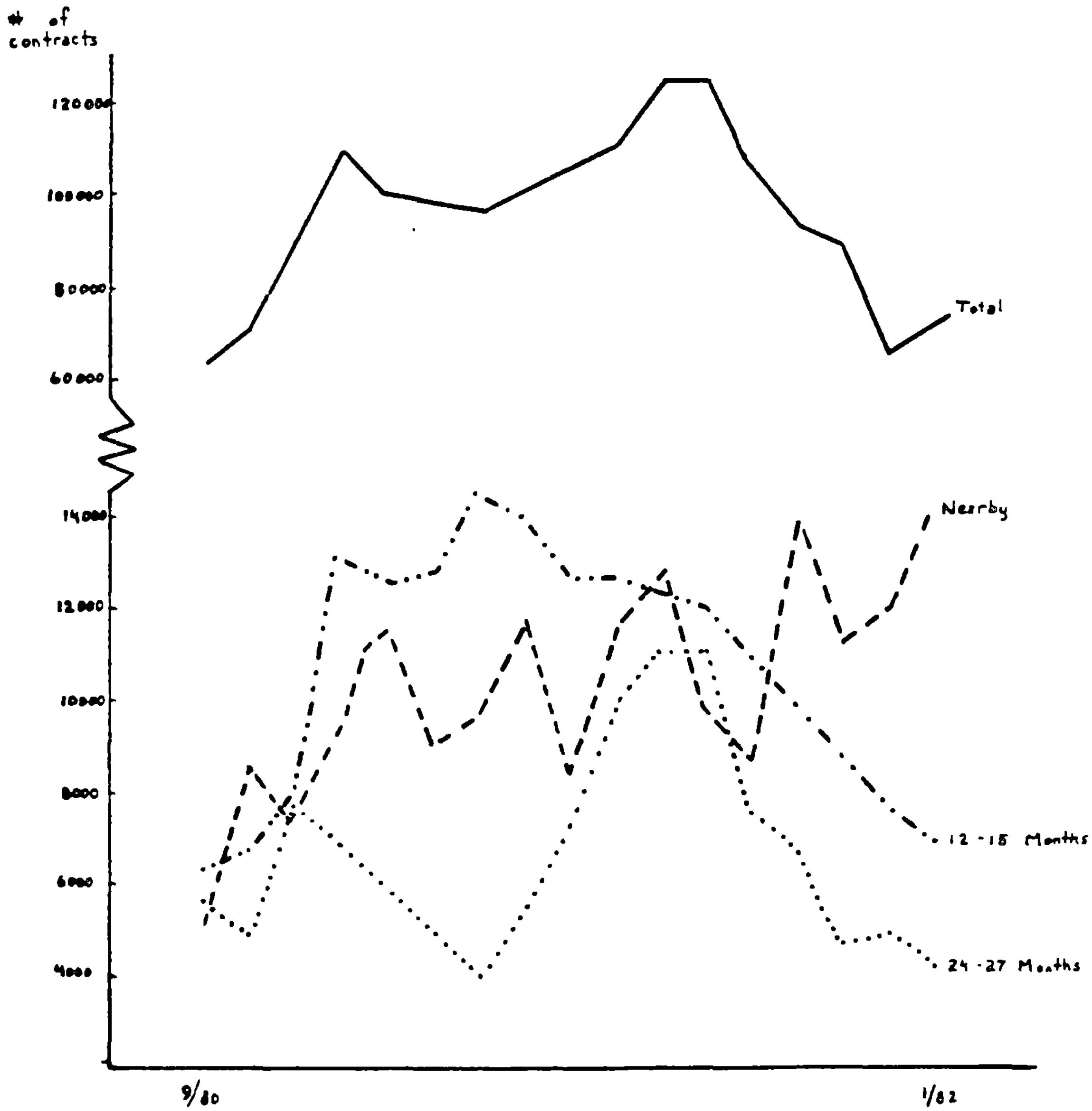


FIGURE 2-6

Daily Open Interest
U.S. Treasury Bond Futures

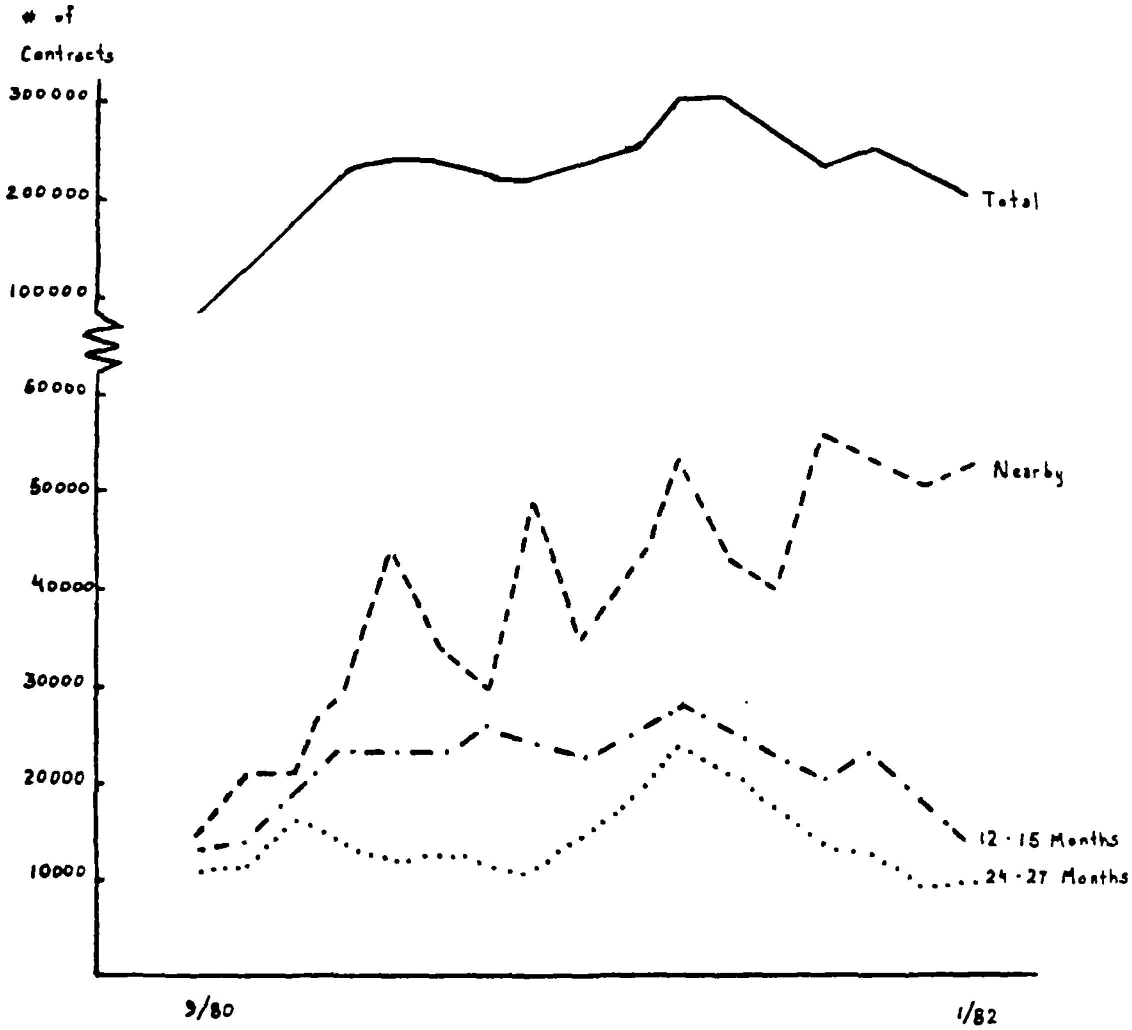


FIGURE 2-7

Daily Open Interest
Canadian Dollar Futures

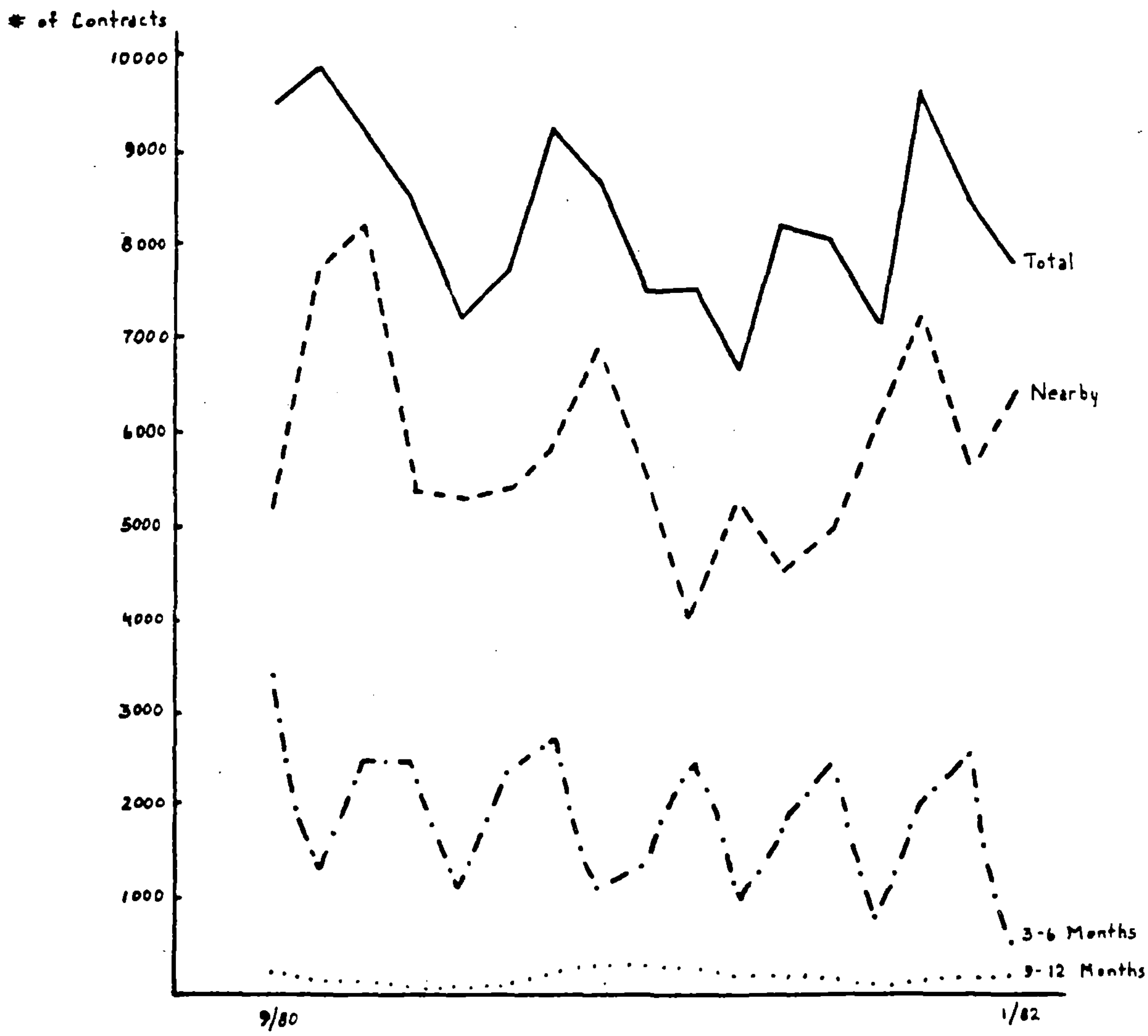
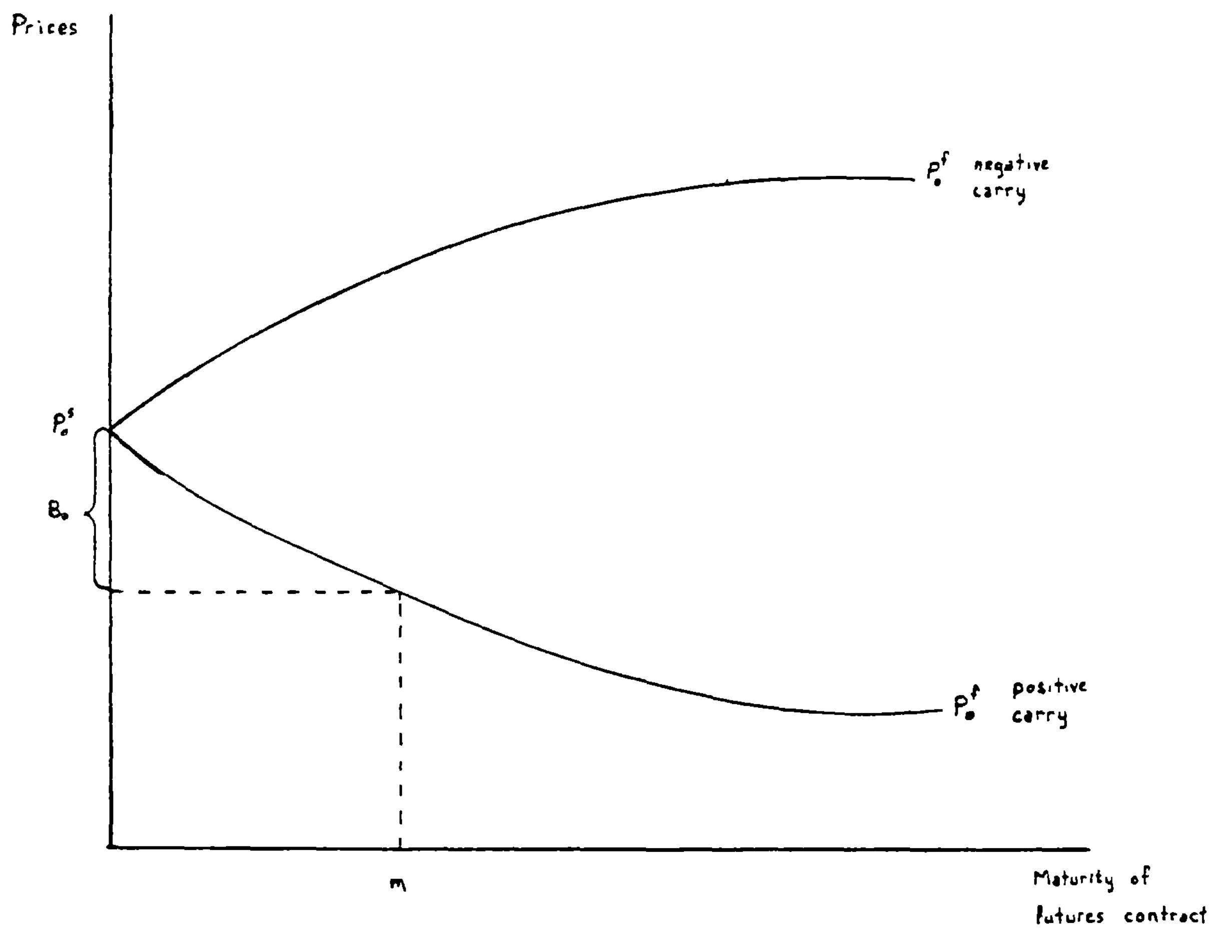


FIGURE 2-8

Spot/Futures Price Relationships



CHAPTER 3 OPTION PRICING AND MORTGAGE RATE INSURANCE

In recent years financial theorists have recognized the relevance of the theory of options to the pricing of certain types of insurance coverage. In particular some insurance contracts require payment of a premium at the current date. If the market value of the insured asset is less than its insured value at the expiration date of the contract then the insurance contract will pay the difference between the market value and the insured value. If market value is greater than the insured value at expiration, no payment is made. Thus, at expiration the value of the insurance, P^*, will be the maximum of either the difference between the insured value, X, of the asset and its market value, V^*, or zero:

$$P^* = \text{Max}[X - V^*, 0] \; . \tag{1}$$

One example of this type of insurance is mortgage default insurance which pays the insured the difference between the insurance value (outstanding mortgage balance) and the market value of the house in a default or nothing if there is no loss.

This type of contract is equivalent to a put option on the asset with an exercise price equal to the insured value of the asset. As described in Chapter 2, a put option on an asset simply pays the difference between the asset price and the exercise price if the asset price is less than the exercise price at expiration and pays nothing otherwise. Since a great deal is known about calls and puts, options theory offers significant insights into insurance contracts of this kind.

The proposed mortgage rate insurance (MRI) is designed to protect borrowers from large changes in monthly payments at the time of renewal or upon takedown of a commitment. With mortgage renewal policies, if interest rates have risen more than the contract deductible, borrowers are paid either a lump sum or a monthly sum to reduce their payments. With commitment insurance under rising interest rates, a claim is paid to lower the effective financing costs of the insured to a specified contract rate. The insurance claims in both cases are equal to the change in the market value of the mortgage produced by the increase in interest rates. If interest rates at renewal or takedown are less than or equal to the contract rate, no payment is made since the market value of the mortgage is greater than or equal to the insured value.

Thus, MRI is exactly the type of insurance for which options theory is applicable. MRI is equivalent to a "European" put -- European because it can be exercised only at the end of the contract. The asset in this case is the mortgage whose market value fluctuates as interest rates vary.

I. Option Pricing Model

The Black-Scholes option pricing model[1] yields the general equilibrium price for a MRI contract if certain assumptions hold.[2] The Black-Scholes European put pricing formula (and thus the insurance pricing solution) is

$$P = Xe^{-rT}N(d_1) - Ve^{-cT}N(d_2) \equiv P(V,X,\sigma,T) \qquad (2)$$

where $N(\cdot)$ is the cumulative, normal density function

P is the insurance premium

V is the current market value of the mortgage

X is the insured value of the mortgage

r is the riskless rate of interest

σ^2 is the variance rate of V

c is the continuous interest rate on the mortgage.

$$d_1 = \frac{-\ln V/X - (r-c+\sigma^2/2)T}{\sigma\sqrt{T}}$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

The insurance premium responds to changes in the equation parameters in a known way given by the partial derivatives:

$$\frac{\partial P}{\partial V} < 0, \ \frac{\partial P}{\partial X}, \ \frac{\partial P}{\partial \sigma^2} > 0 \quad \frac{\partial P}{\partial T} \gtrless 0 \tag{3}$$

These partial derivatives have intuitive interpretations.

1. If the value of the insured asset, V, rises, the asset is less likely to have a value below the insured value. Thus, the insurance contract has a smaller expected payout and the required premium is smaller.

2. If the insured value of the asset, X, is increased (or the deductible decreased), the expected payout is higher and the required premium is higher.

3. If the variance rate, σ^2, or volatility of interest rate increases, there is a higher probability of a large increase in interest rates and a large payout. Thus, the required premium is larger.

4. If the time to expiration T increases, two offsetting effects influence the premium. On the one hand, the greater time of the contract tends to increase the probability of a payout at expiration which increases the premium. On the other hand, the greater time of the contract means that if there is a loss, the present value of the loss is smaller and therefore the premium can be smaller. As a result, a longer term policy does not necessarily mean that higher premiums must be charged! Note, however, that this result holds only if the contract is "European", that is, only if the insurance can be exercised solely at expiration. If the insurance can be exercised at any time during the contract, then longer policies always require higher premiums.

The relationship between the premium and the present value of the mortgage is diagrammed in Figure 3-1. The value of the insurance increases as mortgage value decreases as shown by the curve $P=P(V,X,\sigma,T)$. At expiration the insurance value is given by the line $P=MAX[X-V,0]$. Alternatively, in terms of interest rates instead of the present value of the mortgage, the insurance premiums will follow Figure 3-2 since interest rates and present value are inversely related. The $r(X)$ is the interest rate corresponding to the insured value, X. The $r(V)$ is the current interest rate corresponding to the current present value of the mortgage, V.

II. Implementing the Options Approach - Fair Value Table

In determining the price of MRI the insurer must consider not only the expected payouts, but also administrative costs and reserves. In this section we ignore administrative costs and reserves and concentrate on the equilibrium premiums as derived from the option pricing model. From equation (2) it can be seen that the premium depends on the insured value, X, the time to expiration, T, the volatility, σ, and mortgage value V.

$$P = P(X,V,T,\sigma) \tag{4}$$

Of these parameters the insured value, X, or deductible interest rate can be directly influenced by the insurer. As a result, the expected payout can be affected by the choice of this insured value or deductible. "Fair" insurance is retained if the premium is adjusted downward when the deductible is increased.

Beyond the control of the insurer are the mortgage value, V, and the volatility, σ. As these variables change it will be necessary to adjust the premiums or the insured values accordingly if fair premiums are to remain.

The procedure, then, for implementing the options approach is:

1. Observe the volatility of interest rates and mortgages as well as current interest rate and mortgage value.
2. Choose either a premium, P, or an insured value, X, to be fixed in the insurance contracts.
3. If the insured value is fixed in the previous step, use equation (2) to determine the fair premium. If the premium is fixed, use equation (2) to determine the insured value (i.e., the deductible interest rate).

To illustrate this process, equation (2) can be used to generate tables of insured values given the premium, the volatility, and the term of the contract. These results are presented as Table 3-1.

Consider Table 3-1 with a 1/2 point (.5%) premium for the insurance (i.e., $5 per $1000 face value of the mortgage). Suppose recent interest rate fluctuations produce a mortgage volatility of 3% (annual standard deviation), that is, recent fluctuations in interest rates translate into a standard deviation of 3% for mortgage values. The relevant column then is the second one in Table 3-1 (standard deviation = .03). If the mortgage being insured is a one-year mortgage, then row 1 of the table is appropriate. This table indicates that the proper insured value is a present value of .984. Therefore, the policy should begin to pay the insured if the present value of a one-year mortgage at current rates falls to 98.4% of face value at expiration.

Table 3-2 converts these present values into interest rate deductibles on a 15% mortgage. In Table 3-2 the interest rate deductible corresponding to the 1/2 point premium, a one-year term, and a 3% volatility is 1.762%. In other words, the insured value of .984 means that if the insurer is covering the risk of the borrower with a 15% mortgage for a one-year term and charging a 1/2 point premium, then the policy should begin to pay the insured if rates rise above 16.762% (15% + 1.762%) at the time of renewal in one year. Other figures in Table 3-2 give similar deductibles when the premium charged is 1 or 2 points. The one point premium in this example reduces the deductible to .08%. The two point premium causes a negative deductible of 2.05%, meaning MRI would pay the insured if rates failed to fall below 12.59% (from the 15% level).

In general, the results in Table 3-2 show the relationships among the deductibles, the premium levels and interest rate volatility and risk. For each of the three premium rates, the necessary deductible increases as the standard deviation (volatility) rises. Of course, the higher the premium, the lower the required deductible at any given level of interest rate risk. Also, it should be noted that for each premium, the interest rate deductible declines in most cases as the term of the mortgage increases from 1 to 5 years.

Table 3-2 is derived by holding the premium constant while allowing the deductible to vary with changing terms or market conditions. Alternatively, tables can be constructed which hold the deductible constant and vary the premium. Table 3-3 is such a table for 1-, 3-, and 5-year mortgages. the first column in this table gives the market value to insured value ratio for each mortgage term (a ratio of 1 is equivalent to no interest rate deductible). As the ratio (deductible) rises, the required insurance premium falls.

Volatility

Given the sensitivity of premiums and deductibles to volatility, some care must be taken in choosing a proper value. Note that the model assumes that volatility is constant, but interest rate volatility has tended to vary somewhat. Changes in volatility have also been a problem in the stock market. Traders in stock options have resolved the issue by developing forecasts of future volatility from past values. We will follow a similar procedure here.

In Table 3-4 the quarterly volatilities in annual rates are reported for various Canadian mortgage series and Canadian Treasury bills. The results in this table indicate a great deal of instability in the standard deviations of mortgage interest rates. The annual rates for each quarter range from under 1% to as high as 9%, settling by the beginning of 1982 to the 2-3% level.

Due to the way that the mortgage series are gathered, the Treasury bill data is more reliable for the measurement of interest rate volatility. Mortgage interest rates are administered rates rather than market yields, and the rates are reported as averages of a sample of institutions. These factors tend to create statistical problems in the calculation of volatility that do not exist for the T-bill data. The T-bill standard deviations were fairly stable until the fourth quarter of 1979 after which there is much more volatility. However, the maximum annual rate was still below 5%.

These results suggest that present volatility levels for interest rates and mortgage values are around 3% (annual standard deviation). Referring to Table 3-2, a standard deviation of .03 indicates a possible premium structure for MRI consisting of a risk premium of .5% of the loan balance with a 1-2% deductible depending on the term or commitment period of the insured mortgage. With a risk premium of 1% for a MRI policy, the deductible could fall to the .5% level.

Since the volatility of interest rates does tend to change, it is useful to have a forecasting procedure. In an earlier study it was found that exponential smoothing provides a simple and effective forecast of future volatility.[3] In this procedure the forecast, F_{t+1}, is found from

$$F_{t+1} = F_t + \alpha(A_t - F_t) \tag{5}$$

where A_t is the actual value at t. Applying this procedure to the quarterly variances and choosing α to minimize the mean squared error of the forecast gives rise to the optimal smoothing forecast

$$F_{t+1} = F_t + 1(A_t - F_t)$$
or
$$F_{t+1} = A_t \tag{6}$$

That is, a good forecast is obtained by using the previous actual value.

This forecasting model is applied to the mortgage and Treasury bill series. The results of using equation (5) with alpha (α) levels ranging from .1 to 1.0 is presented in Table 3-5. In the mortgage series the optimal α ranges from .1 to .3. However, the statistical problems discussed earlier reduce the reliability of these findings. With the Treasury bill data the α with the lowest mean square error is at the 1.0 level.

Hedging Ratios

As indicated in the earlier chapters, the risk of writing MRI can be greatly reduced by hedging interest rate risk. In this section the concept is extended to include the option hedge ratio as well as the futures hedge ratio. The terms of the insurance contract have considerable influence over the degree of hedging that is needed to eliminate the risk inherent in MRI.

Recall that the premium can be written

$$P = P(V, X, \sigma, T) \tag{4}$$

and $0 > \frac{\partial P}{\partial V} = -e^{-ct} N(d_2) > -1$. That is, the value of the insurance falls by between zero and one dollar when the market value of a mortgage rises by one dollar. Since the value of the insurance changes in a deterministic way as the value of the mortgage changes, it is possible to construct a riskless portfolio by writing insurance (selling puts) and taking short positions in mortgages (or related interest sensitive instruments). The proper proportions or hedge ratios are given by the partial derivative $\partial P/\partial V$.[4]

These ratios have been calculated for the parameter values of Tables 3-1 and 3-2 and are presented in Tables 3-6. The numbers indicate the quantity of mortgages that should be sold short to eliminate the risk in the insurance. For example, if a MRI policy with a 1/2 point premium is written on a one-year mortgage of \$100,000 when volatility is .03, then \$25,800 (= .258 × \$100,000) of mortgages should be sold short to offset the risk of the insurance.

A number of considerations should be pointed out when applying hedge ratios. Firstly, the hedge ratio changes as the value of the mortgage (i.e., the interest rate) and the time to expiration changes. As a result, the short position must be adjusted periodically if the portfolio is to remain riskless or near riskless.

Secondly, the hedge ratios are smaller for MRI policies with combinations of low premiums and high deductibles. Therefore, less hedging will be needed with this type of insurance. This is an advantage to the low premium, high deductible policy since hedging inevitably involves some transactions costs.

Thirdly, since policies will be written at different times and with differing contract provisions, the proper overall hedge ratio for the insurer is a weighted sum of the hedge ratios for the individual policies. If MRI is implemented, it will be useful to have an on-line procedure for calculating this overall ratio.

Fourthly, the hedge ratios in the tables give the proper amount of mortgages to be shorted. If futures contracts are being used to offset the risk, then the proper ratio is a composite of the option hedge ratio and the futures hedge ratio. The insurer will want to know the sensitivity of the insurance to a change in the hedging asset. This is given by

$$\frac{\partial P}{\partial A} = \frac{\partial P}{\partial V} \times \frac{\partial V}{\partial A} \qquad (7)$$

where A is the hedging asset. Thus, if the option hedge ratio is .5 and the future hedge ratio is .8, the composite hedge ratio is simply $\partial P/\partial A = .5 \times .8 = .4$

III. A Comparison of the Options Approach to Traditional Insurance Approaches

There are two important ways that the options approach discussed in this chapter differs from the approach used by Wyatt Company.[5] The first concerns the term of the insurance contract, while the second pertains to the procedure for calculating premiums.

In the Wyatt schemes the deductible is based on the consumer price index (CPI). In the MRI contracts considered here the CPI is ignored and the interest rate deductible is fixed such that the premium is set at a desired level. There are advantages to each type of contract. The CPI-based deductible attempts to insure against radical changes in real loan payments. The interest rate deductible, however, is simpler and likely to have quicker consumer acceptance and understanding. For a short term policy (e.g., one year) the change in the price level is likely to be relatively small and poorly correlated to the change in interest rates. Only in the longer contracts (3-5 years) will the change in CPI play a significant role.

Therefore, if a CPI-based deductible is used, it should be confined to the long-term contracts.

The second difference concerns the methods of calculating expected losses. The Wyatt study uses 30 years of recent data on prices and interest rates to develop the probability distribution for expected losses. The expected losses are then discounted back to obtain a present value, but the proper discount rate is not elaborated. In the absence of hedging the discount rate should be related to the systematic risk in the contracts. Also, there is no attempt to investigate the stability of the loss distribution. Since economic conditions have changed radically in the last thirty years, changes in this distribution are a distinct possibility.

The options approach assumes a log normal distribution of returns and a constant volatility over the life of the contract (see the Appendix for a further discussion of these assumptions). The parameters of this distribution could also be estimated from 30 years of past data, but using data for the last quarter in this study produced more accurate results. It is clear that economic conditions should be monitored closely if the insurance is to be properly priced.

Also the options approach is based on a hedging strategy. With the hedging strategy the discounting is implicitly being done at the riskless rate because the hedged portfolio is riskless. If hedging is not used, it may be necessary to adjust the premiums for the higher risk of the unhedged position.

Appendix: Some Technical Issues

When estimating expected losses under any insurance scheme, the nature and stability of the underlying probability distribution that is assumed is of considerable importance. The options approach taken here assumes a log normal distribution of returns with constant variance. This assumption was tested using a number of statistical checks. The results of these checks are reported in Table 3-7.

We have already seen that there is a tendency for the annual standard deviation to change over time, perhaps as a result of economic conditions and policy. Table 3-7 reveals that the mortgage series are subject to autocorrelation, but the T-bill series are not. This probably results from the method of data reporting indicated earlier. Because of these difficulties, the Treasury bills data is better for estimating the volatility.

The skewness and kurtosis values test for the log normality of the returns. While skewness does not appear to be a problem, there is substantial kurtosis (fat tails) evidenced in the series. This phenomenon is also apparent in stock prices. It arises because volatility is changing with economic conditions. Practitioners in the stock options markets have successfully adjusted to the problems caused by changes in volatility and the positive kurtosis by forecasting volatility. A similar approach can be followed here. Note that changes in the underlying distribution are a hazard in all insurance schemes. Reserves should be carried to protect against unexpected losses from this source.

CHAPTER 3

FOOTNOTES

1. F. Black and M. Scholes, "The Pricing of Options and Corporate Liabilities", Journal of Political Economy, 91 (May-June 1973): 637-54. For an example of the application of this option pricing model to the pricing of commitments in the mortgage market, see M.R. Asay and D.R. Capozza, "The FNMA Free Market System Auction: Valuation, Bidding Rules, and Hedging Choices", Occasional Papers in Housing and Community Affairs, Volume 9 (Washington, D.C.: U.S. Department of Housing and Urban Development, 1981).

2. The major assumptions include:
   (a) The distribution of the value of the asset at the end of any finite time interval is log normal and the variance rate of return σ^2, or volatility is constant.
   (b) There is a known constant instantaneously riskless rate, r, which is the same for borrowers and lenders.
   (c) Capital markets are perfect. There are no transactions costs and traders have free and costless access to available information.
   (d) Trading takes places continuously.

3. D.R. Capozza and B. Cornell, "Treasury Bill Pricing in the Spot and Futures Markets", Review of Economics and Statistics, 61 (November 1979): 513-20.

4. The rationale behind this hedge ratio is easily seen if we construct a portfolio Z consisting of one put, p, and w mortgages sold short

$$Z = p - wV$$

Then $\partial Z/\partial V = \partial P/\partial V - W$. If W is set equal to $\partial P/\partial V$, then $\partial Z/\partial V = \partial P/\partial V - \partial P/\partial V = 0$; that is, the value of the portfolio does not change as mortgage value or interest rates change. Therefore, the portfolio is riskless.

5. The Wyatt Company, "Insurance Protection Against High Payment Increases on Mortgage Renewal: Further Research Work", September 28, 1981.

TABLE 3-1

RATIO OF MARKET VALUE TO INSURED VALUE

YEARS	.02	.03	.04	.05	.06	.07	.08	.09	.10
				STANDARD DEVIATIONS					
				PREMIUM = 0.5%					
1.	0.995	0.985	0.973	0.960	0.947	0.933	0.919	0.905	0.891
2.	0.990	0.974	0.956	0.938	0.919	0.899	0.879	0.859	0.840
3.	0.986	0.966	0.945	0.922	0.899	0.876	0.852	0.829	0.805
4.	0.984	0.962	0.937	0.911	0.885	0.859	0.832	0.806	0.780
5.	0.983	0.959	0.932	0.904	0.875	0.847	0.818	0.790	0.762
				PREMIUM = 1.0%					
1.	1.006	0.999	0.991	0.981	0.970	0.959	0.948	0.936	0.923
2.	1.004	0.993	0.979	0.965	0.949	0.932	0.916	0.899	0.881
3.	1.004	0.989	0.973	0.954	0.935	0.915	0.895	0.874	0.854
4.	1.004	0.988	0.969	0.948	0.926	0.904	0.881	0.858	0.835
5.	1.006	0.988	0.967	0.945	0.921	0.896	0.872	0.847	0.822
				PREMIUM = 2.0%					
1.	1.022	1.018	1.013	1.006	0.999	0.990	0.982	0.972	0.963
2.	1.024	1.017	1.008	0.998	0.986	0.973	0.960	0.946	0.932
3.	1.027	1.018	1.007	0.994	0.979	0.963	0.947	0.930	0.913
4.	1.031	1.021	1.008	0.993	0.976	0.959	0.940	0.921	0.902
5.	1.037	1.026	1.012	0.996	0.977	0.958	0.938	0.917	0.896
4.	-1.088	-0.752	-0.298	0.242	0.849	1.510	2.217	2.963	3.744
5.	-1.095	-0.788	-0.368	0.133	0.697	1.314	1.974	2.671	3.403

TABLE 3-2

INTEREST RATE DEDUCTIBLES (%)

MORTGAGE CONTRACT RATE = 15%

	STANDARD DEVIATIONS								
YEARS	.02	.03	.04	.05	.06	.07	.08	.09	.10
					PREMIUM = 0.5%				
1.	0.548	1.762	3.162	4.699	6.343	8.078	9.892	11.776	13.725
2.	0.653	1.653	2.789	4.024	5.337	6.715	8.149	9.633	11.163
3.	0.625	1.517	2.528	3.624	4.788	6.009	7.278	8.592	9.945
4.	0.573	1.398	2.332	3.346	4.424	5.555	6.733	7.953	9.211
5.	0.512	1.288	2.170	3.129	4.150	5.224	6.344	7.506	8.708
					PREMIUM = 1.0%				
1.	-0.734	0.080	1.090	2.242	3.506	4.863	6.298	7.803	9.371
2.	-0.255	0.448	1.296	2.247	3.280	4.379	5.535	6.740	7.989
3.	-0.156	0.479	1.238	2.086	3.005	3.981	5.006	6.073	7.179
4.	-0.151	0.433	1.133	1.916	2.764	3.664	4.611	5.597	6.620
5.	-0.188	0.357	1.012	1.747	2.544	3.393	4.286	5.218	6.185
					PREMIUM =2.0%				
1.	-2.463	-2.054	-1.452	-0.705	0.158	1.116	2.154	3.262	4.432
2.	-1.442	-1.047	-0.504	0.147	0.883	1.688	2.551	3.464	4.421
3.	-1.167	-0.801	-0.307	0.280	0.940	1.659	2.428	3.240	4.090
4.	-1.088	-0.752	-0.298	0.242	0.849	1.510	2.217	2.963	3.744
5	-1.095	-0.788	-0.368	0.133	0.697	1.314	1.974	2.671	3.403

TABLE 3-3

INSURANCE PREMIUMS (%)

STANDARD DEVIATIONS

V/X	.02	.03	.04	.05	.06	.07	.08	.09	.10
				1 YEAR					
0.90	8.607	8.607	8.611	8.633	8.685	8.773	8.894	9.045	9.220
0.95	4.306	4.348	4.462	4.636	4.852	5.097	5.361	5.640	5.929
1.00	0.687	1.030	1.373	1.717	2.060	2.403	2.746	3.089	3.432
1.05	0.004	0.058	0.190	0.385	0.621	0.886	1.171	1.469	1.777
1.10	0.000	0.001	0.010	0.049	0.129	0.252	0.412	0.604	0.821
1.15	-0.000	0.000	0.000	0.004	0.019	0.055	0.120	0.215	0.340
1.20	0.0	-0.000	0.000	0.000	0.002	0.010	0.029	0.067	0.127
				3 YEAR					
0.90	6.377	6.401	6.493	6.660	6.886	7.155	7.455	7.777	8.116
0.95	3.254	3.464	3.762	4.107	4.478	4.864	5.260	5.663	6.071
1.00	0.881	1.322	1.762	2.202	2.642	3.082	3.522	3.961	4.400
1.05	0.081	0.317	0.642	1.012	1.407	1.817	2.237	2.663	3.094
1.10	0.002	0.045	0.179	0.397	0.676	0.998	1.350	1.723	2.112
1.15	0.000	0.004	0.038	0.133	0.294	0.511	0.775	1.075	1.403
1.20	0.000	0.000	0.006	0.039	0.116	0.246	0.425	0.649	0.909
				5 YEAR					
0.90	4.730	4.798	4.959	5.189	5.464	5.770	6.097	6.438	6.790
0.95	2.490	2.757	3.086	3.446	3.822	4.206	4.597	4.991	5.388
1.00	0.843	1.264	1.685	2.106	2.526	2.947	3.367	3.786	4.205
1.05	0.151	0.443	0.797	1.180	1.578	1.985	2.397	2.813	3.231
1.10	0.013	0.116	0.325	0.606	0.932	1.287	1.661	2.049	2.447
1.15	0.001	0.023	0.115	0.286	0.522	0.805	1.123	1.466	1.828
1.20	0.000	0.003	0.035	0.125	0.278	0.487	0.742	1.031	1.349

TABLE 3-4

Standard Deviations of Selected Interest Rates*

Period	1-year Conventional Mortgage	3-year Conventional Mortgage	5-year Conventional Mortgage	NHA Mortgage	Treasury Bills
I/78				.001	.006
II/78				.004	.004
III/78				.010	.004
IV/78		.027	.015	.011	.006
I/79		.020	.013	.007	.006
II/79		.012	.007	.001	.005
III/79		.045	.024	.014	.004
IV/79		.078	.058	.031	.018
I/80		.047	.038	.021	.023
II/80		.097	.069	.043	.021
III/80		.031	.021	.017	.021
IV/80	.029	.028	.022	.017	.026
I/81	.004	.016	.012	.003	.002
II/81	.019	.058	.031	.011	.007
III/81	.027	.075	.048	.014	.007
IV/81	.032	.090	.047	.014	.019
I/82	.011	.034	.021		.003

* The standard deviations are annual rates. For the conventional mortgage series, they are calculated on a quarterly basis from weekly data. For the NHA mortgages they are derived on a quarterly basis from monthly rates data. Monthly data for 3-month Treasury bills were utilized to calculate the quarterly rates.

Sources: Surveys performed by Canada Mortgage and Housing Corporation (conventional mortgage data).
Canadian Housing Statistics, Canada Mortgage and Housing Corporation (NHA data).
Bank of Canada Review (Treasury bill data).

TABLE 3-5

Mean Square Errors in Forecasting
Standard Deviations of Interest Rates Series

Alpha (α) Values	1-year Conventional Mortgage	3-year Conventional Mortgage	5-year Conventional Mortgage	NHA Mortgage	Treasury Bills
.1	.0316	.1049	.0765	.0651	.0415
.2	.0312	.1075	.0737	.0619	.0425
.3	.0316	.1101	.0735	.0615	.0429
.4	.0323	.1124	.0738	.0619	.0430
.5	.0333	.1143	.0743	.0628	.0427
.6	.0342	.1161	.0749	.0642	.0421
.7	.0352	.1179	.0757	.0661	.0413
.8	.0361	.1199	.0768	.0685	.0403
.9	.0369	.1225	.0784	.0715	.0391
1.0	.0379	.1259	.0807	.0752	.0380

TABLE 3-6

HEDGING RATIOS

STANDARD DEVIATIONS

YEARS	.02	.03	.04	.05	.06	.07	.08	.09	.10
				PREMIUM = 0.5%					
1.	0.346	0.258	0.208	0.174	0.151	0.133	0.119	0.108	0.098
2.	0.259	0.191	0.153	0.128	0.110	0.096	0.086	0.078	0.071
3.	0.214	0.158	0.126	0.105	0.090	0.079	0.070	0.063	0.058
4.	0.185	0.136	0.108	0.090	0.077	0.068	0.060	0.054	0.050
5.	0.163	0.120	0.096	0.080	0.068	0.060	0.053	0.048	0.044
				PREMIUM = 1.0%					
1.	0.535	0.417	0.343	0.293	0.255	0.227	0.205	0.186	0.171
2.	0.409	0.314	0.256	0.217	0.188	0.167	0.149	0.136	0.124
3.	0.340	0.260	0.211	0.178	0.155	0.137	0.122	0.111	0.101
4.	0.293	0.224	0.182	0.153	0.133	0.117	0.105	0.095	0.087
5.	0.258	0.197	0.160	0.135	0.117	0.103	0.092	0.084	0.076
				PREMIUM = 2.0%					
1.	0.738	0.620	0.531	0.464	0.412	0.371	0.338	0.310	0.287
2.	0.587	0.480	0.405	0.350	0.309	0.276	0.250	0.229	0.211
3	0.493	0.400	0.336	0.289	0.254	0.227	0.205	0.187	0.172
4	0.425	0.344	0.289	0.249	0.218	0.195	0.176	0.160	0.147
5.	0.371	0.302	0.253	0.218	0.192	0.171	0.154	0.141	0.129

TABLE 3-7

Time Series Characteristics of Interest Rate Series

Instrument	Skewness	Kurtosis	Autocorrelations 1	2	3	Number of Observations
Con. Mortgage (1 year)	.58	5.47	.45	.22	.16	77
Con. Mortgage (3 years)	.40	5.23	.38	.32	.12	326
Con. Mortgage (5 years)	.45	4.45	.37	.37	.19	326
NHA Mortgage	2.16	17.30	.04	-.16	-.18	156
T-Bill (3 months)	-.30	5.15	.04	-.07	-.05	261
T-Bill (1 year)	1.56	5.26	.01	-.06	-.07	60

FIGURE 3-1

Insurance Premiums and Mortgage Values

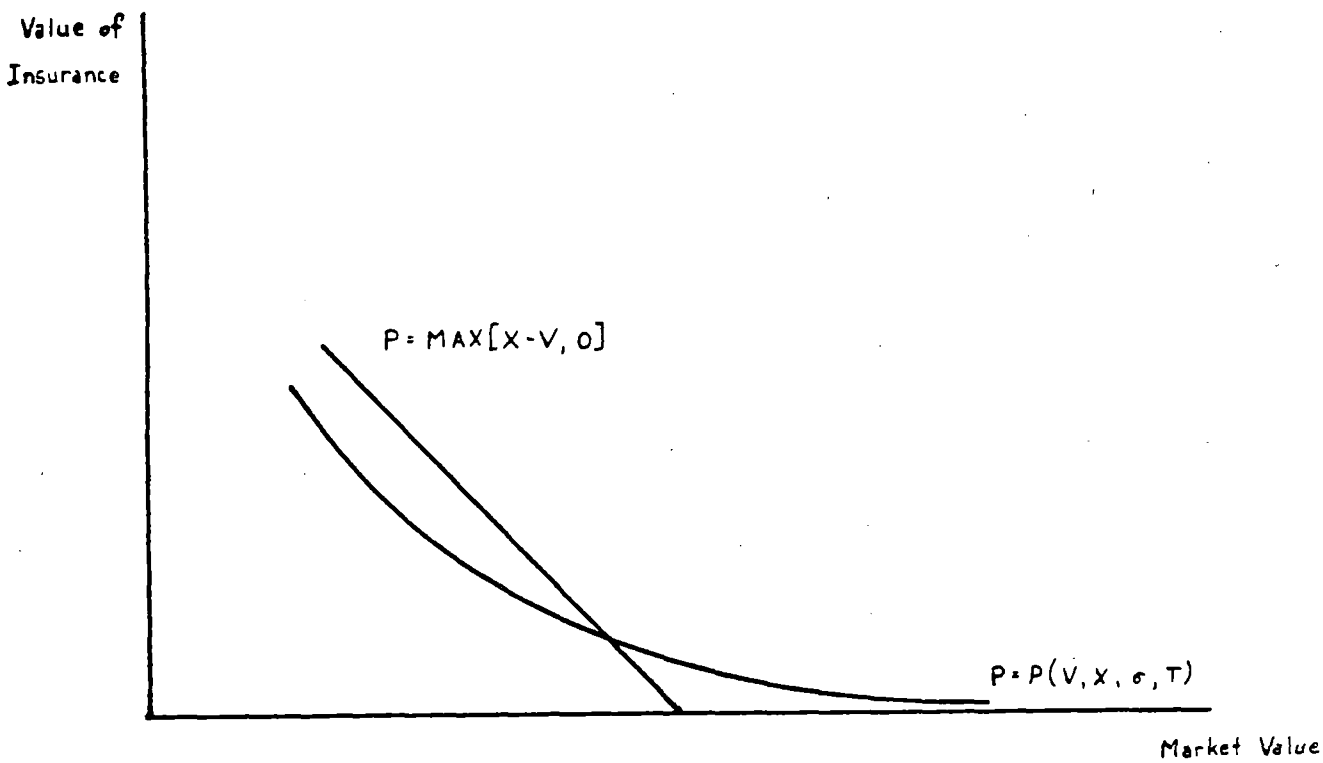
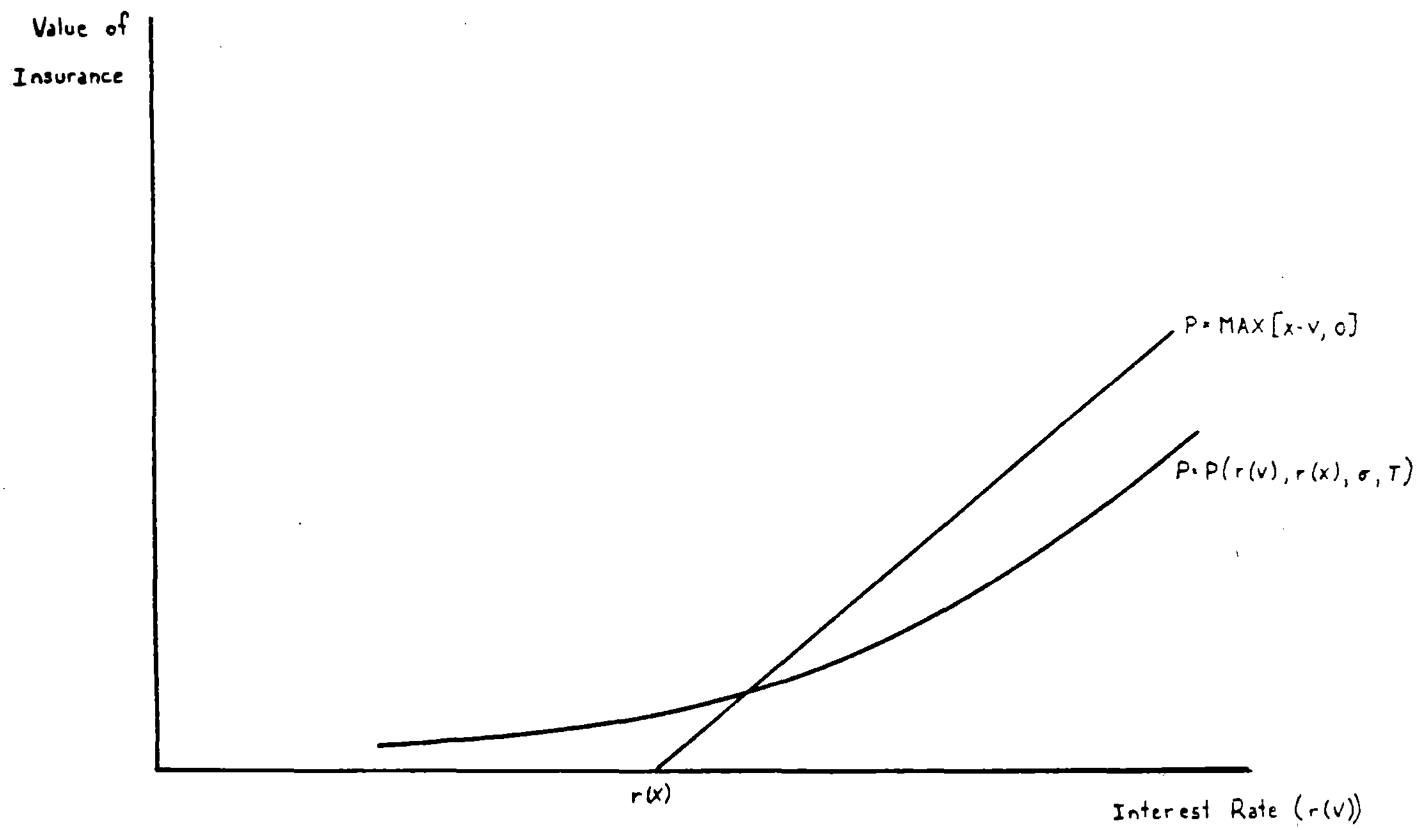


FIGURE 3-2

Insurance Premiums and Interest Rates



CHAPTER 4 CONCLUSION

This study has examined the concept, risk management and pricing of mortgage rate insurance (MRI) as a mechanism for protecting mortgage borrowers from the risk created by volatile interest rates. The first chapter provided an overview of MRI and the workings of the financial futures markets. The second chapter analyzed operational aspects in the use of futures markets for MRI risk management. It also considered options markets as another mechanism for managing interest rate risks. The third chapter developed a pricing model for MRI and estimate a premium/deductible structure.

This final chapter summarizes the results of the study and makes specific recommendations with regard to the suggested form and characteristics of MRI policies as well as the appropriate risk management strategy. It also explores how mortgage renewal insurance could be coupled with various alternative designs of the mortgage instrument.

I. Summary of Findings

The major findings of this study are the following:

1. Given the interest rate volatility found in Canadian financial markets, mortgage rate insurance is a useful mechanism for reducing the interest rate risk presently being absorbed by mortgage borrowers.

The recent jump in interest rate volatility has significantly increased the risk inherent in residential mortgages at the times of commitment and renewal. With the cash flow constraints existing in the mortgage market, neither the lender nor borrower wants to absorb the present levels of interest rate risk. The burden has increasingly fallen on the mortgage borrower through the adoption of short-term rollover mortgages and variable-rate instruments. Given the trend away from long-term mortgages, there is a need for an alternative mechanism in the form of MRI for shifting interest rate risk to a third party outside of the mortgage agreement.

2. Two types of MRI policies could be offered to mortgage borrowers: commitment and renewal insurance.

With MRI commitment policies, developers/investors in real estate projects would receive protection against the risk of mortgage rates at the time of the exercise (takedown) of a floating-rate loan commitment being at a higher level than the commitment rate specified in the insurance contract. Under MRI renewal insurance if interest rates rise, the insurer pays the borrower the difference between the original mortgage payments and the higher payments required by the prevailing market rate of interest at the time of renewal.

3. Financial future markets are a viable vehicle for hedging the risk created by volatile interest rates.

Since their inception in 1975, financial futures markets have grown to become a major hedging vehicle for business and financial institutions. The present liquidity of the U.S. futures markets allows traders to take large hedging positions ($1 billion range) with terms of up to 2 1/2 years without seriously affecting market prices or the fear of being unable to close the position in subsequent periods. While the Canadian markets are young and still growing, the existing liquidity in the these contracts limits traders to smaller futures positions ($1 million range) with hedge terms under one year.

4. A MRI insurer would be able to shift a substantial portion of the interest rate risk inherent in commitment and renewal policies to the futures markets.

For a MRI insurer investing reserves in futures contracts, rising mortgage interest rates could not only cause a greater incidence of MRI claims, but also generate an offsetting cash inflow from rising values of short futures hedges. While instrument and basis relationships would to a degree hamper hedging effectiveness, empirical tests suggest that 50-75% of the interest rate risk in MRI policies can potentially be hedged in the existing futures markets. The preliminary nature of these tests, however, indicates that additional empirical research is needed in this area, especially regarding the hedging effectiveness of Canadian futures markets.

5. Hedging interest rate risk through futures markets is a more difficult task for a MRI insurer than for other hedgers due to the one-sided nature of the insurance contract.

While the MRI insurer has claims if interest rates rise, there are no direct gains in terms of cash inflows if interest rates fall. If the insurer is holding a short futures position when interest rates are declining, there are losses on the futures hedge that are not offset by insurance inflows beyond the initial premium. The insurer must therefore lift hedges if interest rates fall. It is necessary to establish trading rules to place limits on any potential futures losses without substantially increasing transaction costs through the frequent opening and closing of futures positions.

6. Once active trading is initiated in debt instruments, options markets can be another useful mechanism for hedging risk in MRI.

Similar to a futures contract, traders could utilize call and put options in mortgage or mortgage-like instruments to hedge interest rate risk. However, unlike futures hedging, the downside loss in an options position is limited - the loss if rates fall is restricted to the cost of the option. The limited loss in an option trade corresponds well to the insurance position in MRI.

7. The options pricing model can be utilized to derive the risk premiums appropriate for MRI coverage.

Based on the characteristics of the mortgage and the MRI policy as well as the volatility of interest rates, this model derives the combination of MRI premium and interest rate deductible which produces sufficient reserves to compensate for the future MRI claims expected, given the level of risk being underwritten. At present volatility levels of approximately 3% (annual standard deviation), a possible premium structure would consist of a risk premium of .5% of the loan balance with a 1-2% deductible depending on the term or commitment period of the mortgage. With a risk premium of 1% for a MRI policy, the deductible would fall to the .5% range.

II. Recommendations and Implementation

The results of this study indicate that mortgage rate insurance is an economically-feasible product that could be offered to borrowers to reduce their exposure to the risk of uncertain future mortgage payments. A premium structure can be formed for MRI policies which accumulates an insurance reserve sufficient to cover the predictable MRI claims given existing interest rate volatility. The unpredictable risk of a significant increase in future volatility, the catastrophic element in this insurance, can be minimized by closely monitoring interest rate volatility and through proper hedging in the financial futures markets.

Policy Characteristics

Given the innovative nature of MRI, it is recommended that for optimal market acceptance the coverage under a MRI policy be governed by simple interest rate formulas. For MRI commitment insurance, the policy pays a claim if the interest rate on the mortgage upon takedown of a floating-rate commitment is higher than the commitment rate specified in the insurance contract. The claim amount would be the lump sum necessary to lower the effective financing costs of the insured over the first term of the mortgage to the commitment rate.[1]

For MRI renewal insurance a straightforward renewal design is preferred over either the CPI or anchor rate approaches. With such a renewal formula a claim is paid if the borrower's interest rate at the time of renewal is higher than the combination of the original mortgage rate plus any deductible. The payout on a claim would be the amount required to lower the effective interest rate on the mortgage over the new term to the combined insurance rate. In the case of homeowners, the simplest administrative procedure would probably be for the MRI insurer to pay directly the mortgage lender the lump sum necessary to lower the mortgage rate to the insurance rate.

One complication is the situation where the mortgage borrower wishes to renew under a MRI policy for a different term than at origination. For example, an insured borrower completing a three-year term who qualifies for a MRI claim wants to renew for a new term of five years. In cases where the renewal is for a longer period than the insurance term, any claim payout would be limited to the number of years in the original term (in the example, three years). For renewals of shorter terms, the borrower would be paid a lump sum at the end of the second term equal to the present value at that time of the remaining monthly insurance payout.[2]

This study also recommends that a MRI insurer should offer both commitment and renewal coverage on not only residential but also commercial properties. Mortgage borrowers across all sectors of the real estate market are being affected by interest rate risk and there is no economic basis for limiting an unsubsidized MRI product to only homeowners or developers/investors in residential structures. By broadening the potential market for this insurance, the start-up and fixed administrative costs of this product can be spread over a larger number of contracts.

Premium Structure and Reserves

The premium for MRI should be structured in a manner similar to mortgage default insurance. The MRI premium would consist of a single fee payable at the start of the insurance that would cover the term of the mortgage or the commitment period. The premium could be funded through increases in the mortgage balance.

Ultimately, a MRI insurer should offer mortgage borrowers a variety of insurance coverages with respect to premiums and deductibles. Such a wide spectrum of policies would allow borrowers to select their optimal risk exposure (in terms of deductible) given risk preferences and cash flow considerations. However, for marketing and management reasons, the insurer would probably want to limit the initial MRI policies to contracts with low premiums and larger deductibles rather than high premiums and smaller or negative deductibles. The primary purpose of this insurance is to protect borrowers at a low cost against major upswings in their monthly payments.

This approach suggests a risk premium on initial MRI policies of not more than .5% of the mortgage balance. The analysis in Chapter 3 indicates that such policies would have deductibles ranging from 2% (one-year term) to 1% (five-year term) given present interest rate volatilities.[3] The insurance premium also needs to cover the administrative and management costs of MRI. In mortgage default insurance these costs generally amount to about 20-30% of the premium. In addition, small reserves should be created for futures trading losses and any residual catastrophic risk not effectively hedged in the futures markets. These costs and reserves are estimated to require an additional premium element of around .25%. The suggested total premium for MRI coverage is therefore .75% of the insured mortgage balance. As an example, the required MRI premium on a $50,000 mortgage would be $375.

Risk Management Strategy

A MRI insurer should form a management group with responsibility for hedging the interest rate risk in MRI policies in the financial futures markets. While the premium reserves can be relied on to satisfy the predictable claims given existing interest rate volatility, over long time periods, to keep reserves modest it is imperative that this risk be laid off through futures hedging or by some other mechanism.[4] MRI can be subject to catastrophic losses without an effective risk management strategy.

At first that strategy would entail the insurer taking only small positions in Canadian futures markets with the major hedging in U.S. markets. Eventually, as the liquidity of Canadian markets increased (a process that would likely be quickened by the trading of a MRI insurer), there would be a shift of hedging activity from U.S. to Canadian markets. The insurer would need to develop a management information system to keep track of the risk exposure in the MRI insurance portfolio as well as the offsetting futures positions.

As indicated in Chapter 2, the MRI insurer has a one-sided risk position requiring an active hedging strategy to protect against downside losses in the futures market. Trading rules should be employed to govern the activities of the risk management group and limit the trading losses in short futures positions if interest rates fall. A reserve should be created for potential futures losses. Such a reserve would give the traders greater flexibility in their hedging strategy.

III. Alternative Mortgage Instruments

While MRI has been designed specifically for the standard rollover instrument, it could also be utilized with other alternative mortgage forms. A variety of mortgage instruments have been proposed for addressing the "tilt" and affordability problems perceived in the rollover mortgage under inflationary conditions.[5] Among the alternative forms that have been discussed include the graduated-payment mortgage (GPM), the shared-appreciation mortgage (SAM) and the price-level-adjusted mortgage (PLAM). Basically, these instruments have the common characteristic of altering the nominal payment stream of a mortgage in an attempt to correct for the tilt of the real payments with inflation.

Graduated-Payment Mortgage

Under a GPM design the early nominal payments on a mortgage are lowered below the corresponding level on a standard mortgage instrument, but the mortgage payments then rise over the life of the loan in a predetermined pattern. Although the monthly payments in the initial years of the mortgage are insufficient to cover the interest and principal, the rate and form of graduation of the payments is derived such that the mortgage is fully repaid by the end of the amortization period. A recent variation of the GPM is the deferred mortgage design.[6] With this instrument a below-market interest rate is selected for use in calculating the nominal mortgage payment, and the difference in the mortgage payment arising from employing this rate instead of the market rate is deferred for some period and then added to the outstanding mortgage balance.

With any GPM design the graduation and interest rate risk aspects of the instrument can be separated into two components. In essence the important feature of a GPM is that it has a payment or interest rate discount from the going market rate in the early years of the loan. This discount can be held constant, while the market rate is subject to change at the end of a specific mortgage term. MRI contracts could then be offered on GPMs in a manner similar to the standard rollover mortgage. Such insurance policies would protect the GPM borrower from the risk of changes in the market interest rate at the end of the term.

The risk management strategy of a MRI insurer would be unaffected by the GPM design. Also the insurance premium percentages would be similar to a rollover mortgage of a comparable term; however, the loan balance used in the premium calculation would differ in this case due to the rising mortgage principal inherent in a GPM. The MRI premium for a GPM should be based on the expected outstanding mortgage balance at the end of the term rather than the original balance at the start of the loan.

Shared-Appreciation Mortgage

By incorporating the impacts of inflation on housing values into the mortgage design, the SAM enables mortgage borrowers to redistribute forward the resulting equity gains in the house to help offset the higher mortgage payments produced by inflation. Under a SAM design the mortgage lender receives a contingent interest in the property securing the loan. In return, the interest rate on the SAM is set at a level below going market rates.

Similar to the GPM, the interest rate risk element in the instrument can be identified and insured through a standard MRI renewal policy. The interest rate discount in the SAM is held constant while the market rate is subject to change at the end of the mortgage term. The MRI contract would protect the SAM borrower from an increase in the mortgage payment (after recognition of the discount) at renewal. The risk management strategy and premium structure would be comparable to the standard rollover mortgage of the same term.

Price-Level-Adjusted Mortgage

With a PLAM, the mortgage interest rate is set at the level of the real rate, the interest rate that would exist in the absence of an inflation premium. The nominal mortgage payments and the outstanding mortgage balance are then adjusted periodically in accordance with changes in a price index. The indexing of the mortgage payment and principal makes it possible to significantly reduce the initial PLAM payments.

Renewal features can be incorporated into the PLAM design to allow adjustments of the real mortgage rate at the end of a given term. A MRI contract could be offered under which the insurer absorbs the risk of a rising real rate. An insurance claim would be paid to the borrower to offset any increase in nominal mortgage payments caused by a higher real interest rate at renewal. The PLAM borrower retains responsibility for that portion of a change in nominal payments caused by inflation.

Unlike the GPM and SAM, a MRI policy on a PLAM entails a substantially different risk management strategy and premium structure than the standard mortgage instrument. The insurer would attempt to hedge the risk of changes in the real mortgage rate. Such a strategy would create problems for the insurer since existing futures contracts are denominated in nominal interest rates. The MRI premiums on a PLAM would be determined by the volatility of real interest rates rather than the nominal rate volatility utilized in the option pricing model in Chapter 3 of this study.

CHAPTER 4

FOOTNOTES

1. For moral hazard reasons it may be necessary to place limitations on the coverage in MRI commitment policies to restrict the payout to only a portion of the claim. As discussed in footnote 11 in Chapter 1, there is a possibility in this insurance for collusion between the mortgage lender and borrower whereby the interest rate at takedown is set higher than market rates in return for the borrower receiving some other contractual benefits. Requiring the borrower to participate in any losses through limitations on the coverage would help protect the MRI insurer from intentional loss creation.

2. A premium structure can be derived through the option pricing model which allows for different insurance and renewal terms. However, such a structure would still require the borrower at the start of the insurance to select a future term for the mortgage when it is renewed.

3. Given the importance of interest rate volatility in the option pricing model, additional research should be performed on the measurement and forecasting of this parameter before a final premium structure is established for MRI policies.

4. Futures hedging has the potential for reducing the risk compensation factors in the MRI premium below the levels necessary if all the predictable risk was absorbed by the insurer. The extent of the premium reduction depends on the effectiveness of futures hedging as well as the existence of risk premiums in futures prices. As mentioned in footnote 16 in Chapter 1, there is an unresolved controversy over whether speculators in the futures markets act as insurers and require compensation for assuming interest rate risk, or rather act more as gamblers seeking the risk offered by speculation in future contracts. If speculators seek compensation through risk premiums in future prices, then the predictable risk elements in MRI premiums could not be reduced through futures hedging, since the MRI insurer would need to pass through the premiums to the purchasers of its short futures positions. For an example of a recent empirical study addressing this issue, see K. Dusak, "Futures Trading and Investor Returns: An Investigation of Commodity Market Risk Premiums", Journal of Political Economy, 6 (December 1973).

5. Analyses of these alternative mortgage instruments are provided in D.R. Lessard and F. Modigliani, "Inflation and Residential Financing: Problems and Potential Solutions", Capital Markets and the Housing Sector: Perspectives on Financial Reform, edited by R.M. Buckley, J.A. Tuccillo, and K.E. Villani (Cambridge, Massachusetts: Ballinger Publishing Company, 1977); G.W. Gau, "An Examination of Alternatives to the Rollover Mortgage", Discussion Paper prepared for Canada Mortgage and Housing Corporation , June 1981; and, J.L. Carr and L.B. Smith,

"Inflation, Uncertainty and Future Mortgage Instruments", North American Housing Markets into the Twenty-First Century, edited by G.W. Gau and M.A. Goldberg (Cambridge, Massachusetts: Ballinger Publishing Company, 1982).

6. J.R. Kesselman, "Mortgage Policies for Financial Relief in Inflationary Periods", Canadian Public Policy 7(Winter 1981): 82-93.