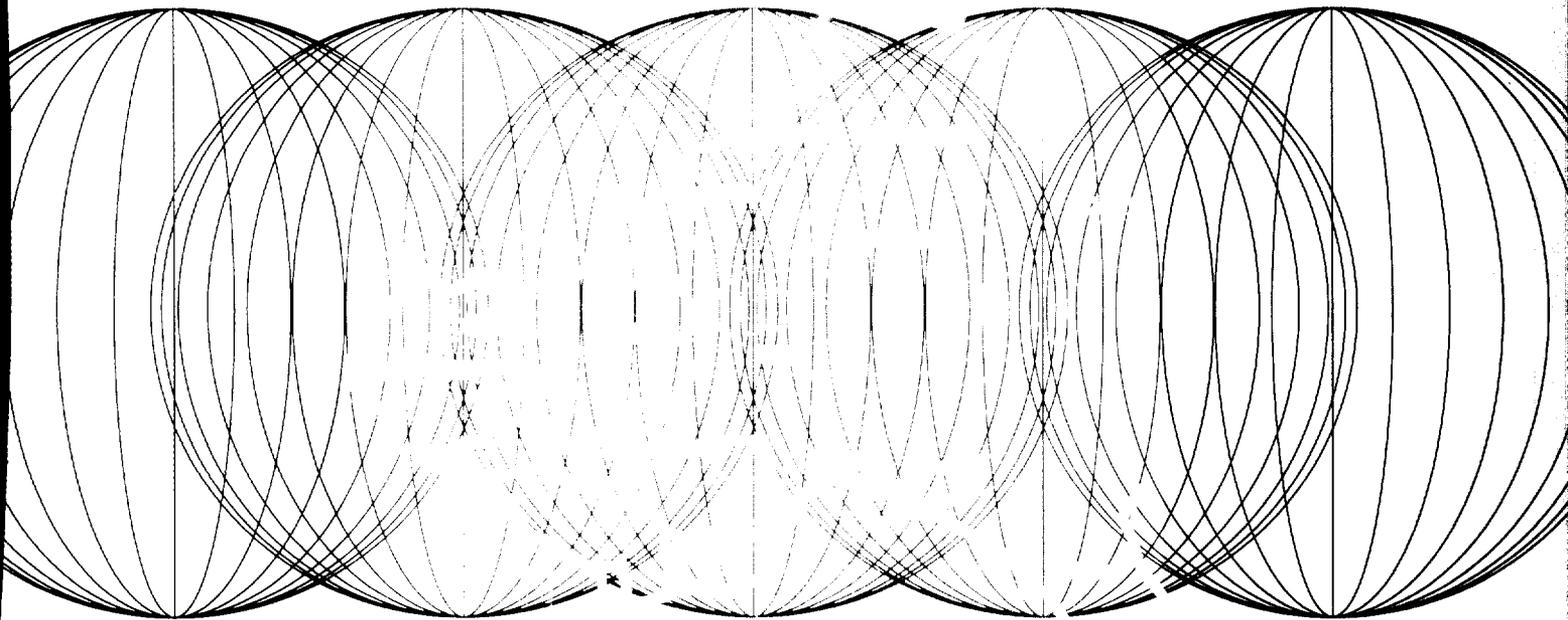


# **FROM PLANNING TO MARKETS HOUSING IN EASTERN EUROPE**

**Mortgage Lending Training Course:  
Basics of Mortgage Pricing**

**Instructor's Guide and  
Training Materials**



**THE URBAN INSTITUTE**  
**Prepared for the Office of Housing and Urban Programs (USAID)**

PJ-ABY-505

**Mortgage Lending Training Course:  
Basics of Mortgage Pricing**

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Training Materials**

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## **Introduction**

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This course *Basics of Mortgage Pricing* is designed to provide participants with a general overview of the principal issues in pricing residential mortgages. It was developed for training bank personnel in Russia but can also be used in other countries.

This course has been designed to be taught in two days. However, sections can either be abbreviated or omitted completely so that the course can be taught in less time. The course can also be a three day course. Specifically, the instructor can extend the amount of time for discussions and/or extend the amount of time spent in the computer laboratory. Two blank course schedules are provided as well as a blank schedule that can be used to design a custom course.

This Instructor's Guide contains all of the materials that you will need to plan and present this course. The guide is organized into 10 sessions. Each one begins with a notation of the time allotment and the suggested teaching methods. A lecture outline follows, with adequate space provided in the left margin for you to write your own notes or sample questions to stimulate discussion or to provide cues to help you during your presentation.

It is important to recognize that these sessions are not meant to be read "as is." It is your responsibility as the course instructor to bring these sessions alive, and to make each topic interesting and practical. In particular, the sections of each session that pertain to issue in Russia should be turned into a discussion session. Keep in mind that a lecture does not necessarily encourage class participation. Thus, the lecture only gives you limited opportunity to know if your students understand the material. For this reason it is important that you augment your lecture with questions that promote understanding and stimulate an exchange of ideas. Questions should come naturally and follow logically in response to the material covered. It is a good idea to pose a question, allow the class to think about it and then solicit an answer.

Finally, in order to keep the course fresh, each time you give this course you should update the lectures with information on changes in

laws, the regulatory environment, the economy and business practices.

A collection of master pages for producing overhead transparencies are provided following the lectures. These overheads can be used to illustrate your lectures making it more appealing and easier to follow.

(Please note that It is not necessary to use all of the overhead provided.)

It is a good idea to periodically revise these overheads to reflect changes in the course.

The discussion and examples in this manual are based on use of the Deferred Adjustable Instrument for Russia ("DAIR"). However, the methodology underlying the discussion is not instrument specific and is sufficiently general to apply to a wide variety of instruments.

This course is also supplemented by computer spreadsheets designed to analyze the concepts of default risk pricing and interest rate risk pricing given a DAIR mortgage. The outlines for utilizing these models are listed under Session A and Session B at the end of this guide.

**Recommended Course**

| <b>Day 1</b>   | <b>Day 2</b>  | <b>Day 3</b> |
|--|---|--------------|
| Introduction & Overview of Mortgage Pricing<br><br>Pricing Risks:Credit Risk                                       | Pricing Risks, cont.:<br><br>Liquidity Risk<br><br>Operating Costs                    |              |
| <b>Break</b>   | <b>Break</b>  | <b>Break</b> |
| Pricing Risks, cont:<br><br>Credit Risk<br><br>Computer Exercise 1 - Dair Default Risk Model                       | Exercise 1 - Mortgage Pricing   |              |
| <b>Lunch</b>   | <b>Lunch</b>  | <b>Lunch</b> |
| Pricing Risks, cont.:<br><br>Interest Rate Risk<br><br>Computer Exercise 2 - Dair Interest Rate Risk Pricing Model | Mortgage Pricing - Putting it all Together<br><br>Course Summary<br>Question & Answer |              |
| <b>Break</b>   | <b>Break</b>  | <b>Break</b> |
| Pricing Risks, cont.:<br><br>Options Risk<br><br>Spread Risk   | Exam<br>Question & Answer<br>Delivery of Certificates                                 |              |

**Blank Course Planner**

| <b>Day 1</b> | <b>Day 2</b> | <b>Day 3</b> |
|--------------|--------------|--------------|
|              |              |              |
| <b>Break</b> | <b>Break</b> | <b>Break</b> |
|              |              |              |
| <b>Lunch</b> | <b>Lunch</b> | <b>Lunch</b> |
|              |              |              |
| <b>Break</b> | <b>Break</b> | <b>Break</b> |
|              |              |              |

**Blank Course Planner**

| <b>Day 1</b> | <b>Day 2</b> | <b>Day 3</b> |
|--------------|--------------|--------------|
|              |              |              |
| <b>Break</b> | <b>Break</b> | <b>Break</b> |
|              |              |              |
| <b>Lunch</b> | <b>Lunch</b> | <b>Lunch</b> |
|              |              |              |
| <b>Break</b> | <b>Break</b> | <b>Break</b> |
|              |              |              |

# Session 1

## Introduction & an Overview of Mortgage Pricing

***Time: 1.0 hour***

***Format: Lecture and discussion***

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- [1. Introduce yourself- talk about your background]
- [2. Have each class member introduce himself or herself. Use this as an opportunity to gauge the level of banking expertise in the class]
- [3. Review the format of the class- material to be covered, activities, breaks etc.]

### ***Introduction:***

Mortgage pricing is defined as providing a yield on the mortgage sufficient to cover marginal funding costs, operating costs and expected losses, and provide an acceptable return to equity investors.

### ***[Show Overhead 3 here]***

The yield is the internal rate of return over the life of the loan which may be *different* from the initial rate on the loan. Equity investors are the bank's shareholders. In establishing a rate on their mortgages, banks must take into account the risks of making and funding the loans. These risks include:

- Credit risk
- Interest-rate risk
- Spread risk
- Liquidity risk
- Options risk

In addition, the rate must include: a spread to compensate the bank for its incremental costs of originating, servicing and funding the loans. These components, when added to a base funding rate, will generate a break-even risk adjusted yield for the bank. Finally, a profit spread must be added to this yield to determine the rate to the borrower.

**Note:**

Pricing mortgages in Russia is complicated by the lack of experience and legal basis for this type of lending as well as an unstable economic environment. Thus, the parameter values used in the discussion and examples are meant to be illustrative and do not constitute recommendations for lenders. This point should be made to the students

*Theory:*

This section will provide an overview of the components of mortgage pricing and an overview of the topics that will be covered in the rest of the course.

In order to provide an acceptable return on investment, mortgage investments must be priced at a spread over the cost of the marginal source of funds.

**[Show overhead 4 here]**

This spread must account for the expected costs of investing in a portfolio of mortgages and a targeted return on investment for the owners of the bank. The expected costs include premiums for the risks of mortgage lending and the operational costs of raising funds and making loans. Specifically, these factors include:

- Credit Risk - Potential loss due to borrower default;
- Interest Rate Risk - Potential loss deriving from mismatched funding (e.g., if loan rates adjust less frequently than funding rates in a rising interest rate environment);

- Options Risk - Reinvestment loss due to early redemption of fixed-rate mortgages (prepayment risk) and funding loss associated with locking a rate to a borrower prior to funding (commitment risk). These costs can be zero if prepayment is precluded, the mortgage rate is not fixed, or rates are not locked until funding;
- Spread Risk - Potential loss deriving from change in funding margin (relative to a reference rate) if lending with a fixed margin (relative to a reference rate);
- Liquidity (Marketability) Risk - Cost of maintaining reserves or lines of credit, or losses associated with the sale of assets to raise cash;
- Administrative Cost - Marginal cost of raising funds, originating mortgages and servicing mortgages;
- Profit Spread - The targeted return on shareholder investment, net of expected losses and costs, necessary to compensate investors for the uncertainty of cost and loss estimates (e.g., through increased volatility in interest rates) and the opportunity cost of their investment.

***[Show overhead 5 here]***

The mortgage yield can be expressed as the sum of the marginal funding rate and the spread components listed above. The interbank interest rate is used as the benchmark for the mortgage rate. The interbank rate is likely to be the closest approximation to a market rate currently in Russia. Other proxies for the marginal cost of funds can be used, including the Central Bank discount rate or the rate on short term (i.e., one month) time deposits.

***[Show overhead 6 here]***

***[This is a good place to have a discussion about the current interbank interest rate. What level is at? What is the current forecast? How are the respective class members utilizing the rate?]***

***[Solicit general questions before moving on]***

**Important**

Whatever index is used it is important that it be market determined and reflect the costs of raising additional funds rather than the bank's historical liability costs.

## Session 2 Credit Risk

***Time: 1 hour***

***Format: Lecture and discussion***

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***[Show overhead 7 here]***

**Theory:**

Credit risk refers to the potential loss to the lender in the event of a loan default. Loan default is an expected occurrence in mortgage lending. Loan default is the failure of a debtor to make timely payments of interest and principal as they come due.

Causes for loan defaults can be classified as either systemic or non-systemic.

Systemic causes of loan defaults include widespread property price decline, unemployment and other macro-economic factors.

***[Show overhead 8 here]***

Non-systemic causes of loan defaults include individual borrower or property specific reasons such as reduction of income and declining home value.

Because systemic causes of default are difficult to manage, lenders concentrate on managing/mitigating non-systemic causes of lender default.

Non-systemic default can be reduced through underwriting. Underwriting is the process of analyzing risk and determining an appropriate charge for taking on the risk. It involves analyzing and determining the borrower's willingness and ability to pay for a mortgage *before* the mortgage is granted.

***[Underwriting is a very important concept. It might be useful to engage a discussion of underwriting at this point. In what type of underwriting do the class members engage? How important is underwriting to them? What are the main constraints to underwriting in Russia?]***

While it is important for an institution to be conservative in its underwriting, there is a cost associated with overly conservative

underwriting. This cost takes the form of profitable lending opportunities foregone. The institutional goal of underwriting, therefore, is to keep default rates (and costs) within an acceptable (typically non-zero) range.

The main factors underlying mortgage default are the borrower's ability-to-pay and willingness-to-pay.

Ability-to-pay is principally determined by the relationship between the borrower's income and the mortgage payment. The borrower must be able to meet basic living expenses and outstanding financial obligations and still have enough money to pay a mortgage- typically with a reserve margin.

Willingness-to-pay is principally determined by the relationship between the market value of the mortgage and the market value of the property.

Additional factors include the borrower's ability to sell the property within the allowable period of mortgage arrears and the borrower's perception about the likelihood of the bank initiating and a court approving foreclosure.

***[Show overhead 9 here]***

There are several costs to lenders of mortgage default. These include:

- Loss if the proceeds from sale of a repossessed house are less than the outstanding balance (including accrued interest) on the loan.
- Administrative costs of managing defaulted loans and repossessed properties.
- Costs to maintain, repair and market repossessed properties.
- Lost interest or principal associated with forbearance or restructuring of defaulted loans.
- The time necessary to obtain the property through foreclosure.

***[Show overhead 10 here]***

***Management:***

Credit risk is managed through setting of guidelines for acceptable risk exposure- typically by a credit committee made up of the senior management of an institution.

***[A short discussion on credit committees may be appropriate here]***

**Ability-to-Pay**

The principal underwriting guideline associated with ability-to-pay is the loan payment-to-income ratio (at the time the loan is granted and that expected in the future). This is simply the amount of the monthly loan payment divided by the a borrower's monthly income.

**Willingness-to-Pay**

The principal underwriting guideline associated with willingness-to-pay is the loan-to-value ("LTV") ratio (both initial and expected in the future).

Values for these two ratios are generally established *before* lending commences. Furthermore, they are reviewed periodically in light of changes in economic conditions and property market conditions.

Individual loans are underwritten according to the guidelines with emphasis on accurately establishing borrower income and the value of the property (e.g., through an appraisal process).

### **Appropriate Pricing of Interest Rate**

In order to be compensated for the potential risk of default, the banker must include an adequate spread component to the mortgage interest rate and/or charge an appropriate level of up-front fees to originate the mortgage.

***[Show overhead 11 here]***

### **Geographic Diversification**

Credit risk can be reduced through geographic diversification, as house price changes in different regions often vary. For example, real house prices in different U.S. regions have varied considerably over the past decade (USChg refers to the evolution of average real house prices for the entire country and NE, MidW, South and West refer to the Northeast, Midwest, Southern and Western regions of the country respectively). Nationwide lenders fared better than those with loans concentrated in specific geographic areas of the country.

### **Development of Robust Mortgage Instruments**

The mortgage instrument used in any particular housing market must reflect the economic realities of that market. The mortgage instrument must strive to protect both the lender as well as the borrower. While this is not always an easy thing to do there are many different types of mortgages available to the banker that can help achieve this goal. For example, in environments, such as the USA, that have stable inflation and stable and low interest rates a fixed rate of interest mortgage is often optimal for the mortgagee and mortgagor. This type of instrument does not make sense in inflationary environments. A fixed rate mortgage might subject the institution to potentially high interest rate risk. To make up for this risk the bank would have to price the mortgage high, which could present a problem of affordability to the borrower. Such a price might lead to an ability-to-pay problem and thus default. There are, however, mortgages designed to operate

in inflationary economies such as the DIM and the DAIR- both discussed below.

***[If there is time talk about other examples such as a variable rate mortgage etc.]***

***[It is not necessary to completely present the following section. Its purpose is to provide tangible of examples of credit risk issues in Western economies]***

***Western Guidelines:***

Lending institutions establish guidelines for acceptable payment-to-income and loan-to-value ratios. Payment-to-income ratios typically range between 25 and 36 percent, depending on the loan type, country and definition of payment and income; This ratio can be defined narrowly to include only the mortgage payment or broadly to include property taxes, insurance, utilities and other housing specific expenses.

Maximum loan-to-value ratios are typically 80 percent. Loans for amounts in excess of 80 percent of value can be obtained but must be insured or underwritten independently of the first mortgage. It should be noted that in Western housing finance systems there can be multiple liens on a property. Priority is typically given to the earliest registered lien and other liens are subordinated to the first lien. As such they have higher risk and typically a higher rate.

In developed housing finance systems, most credit losses come from loans with LTV's greater than 80 percent. In the U.K. and the U.S., third party companies provide mortgage insurance which covers this risk. Mortgage insurers will cover a percentage (sometimes up to 100%) of the mortgage loan in exchange for an up-front fee or additional spread over the mortgage rate. Mortgage insurance will also cover all or a portion of expenses such as hazard insurance and property taxes if the property is repossessed by the lender.

It should be noted that the mortgage insurance companies subject the prospective borrower to extensive underwriting criteria and do not provide a policy on all who apply.

The 80 percent threshold in developed housing finance systems is premised on relative house price stability. As the stability of house prices has yet to be established in Russia, credit risk is likely to exist, and should therefore be priced, in loans with LTV'S less than 80 percent

In some European countries, incremental funds can be obtained from other lenders (e.g., unsecured personal or "top-up" loans) or from the primary lender at a higher rate.

**[Show overhead 12 here]**

**Representative Credit Risk Pricing- 90% LTV**

| Country        | Allocation Method  | Pricing (%) |
|----------------|--------------------|-------------|
| Denmark        | Top-up loan        | 0.34        |
| France         | Primary loan       | 0.78        |
| Germany        | Top-up loan        | 0.31        |
| United Kingdom | Mortgage insurance | 0.63        |
| United States  | Mortgage insurance | 0.35        |

Source: Diamond and Lea (1992)

The "% pricing" column in exhibit 1 are 1990 values for representative borrowers and loans. This column shows the increase in the interest rate on the entire loan amount. If the exposure over 80 percent is priced separately, the loan rates would range from 3 to 7 percentage points over the rate on the primary (i.e., LTV less than or equal to 80 percent) loan. These values can change over time as expectations about loan default and property market conditions change.

The pricing differences in Exhibit 1 reflect differences in the mortgage instruments and lending conditions in the various countries. The Danish, German and U.S. credit risk premiums were the lowest in the 1990-1991 period. German underwriting guidelines are very conservative and default is rare.

The United States benefits from a well developed information base on mortgage default and considerable geographic diversification. Diversification can reduce risk (volatility of returns) if the returns on loans made in different geographic regions or for different purposes are uncorrelated or negatively correlated. Thus the risk of lending in two different geographic areas may be less than that of lending within one area if the economic performance (and resultant property values) diverge.

Denmark, Germany and the United States rely primarily on fixed-rate mortgages. Because nominal mortgage payments are constant over the life of the loan, mortgage default due to payment shock (the loan payment rising faster than income) is mitigated.

France and the United Kingdom have significantly higher credit risk premiums. Default (in recent years) is more common in the United Kingdom, reflecting high LTV loans, an illiquid housing market and almost exclusive use of variable-rate mortgages. Also the property market is geographically concentrated. Higher default costs in France reflect the fact that foreclosure laws strongly favor borrowers (the average time to foreclose ranges between 2 and 4 years) and appraisal methods are relatively undeveloped.

Credit risk premiums in all of these countries are competitively set and rely on time series data relating mortgage and economic characteristics with mortgage payment history. All of these countries use some form of risk-based pricing (i.e., loan rates or insurance fees rising with LTV reflecting greater risk with lower borrower down payment).

It may be instructive to look at the French market as the closest analog to Russia. The difficulties of repossession by lenders and the vagaries of property valuation increases the credit risk premium. As a result, mortgage lenders rarely make loans in excess of 80 percent of estimated property valuation and rely primarily on verification of income in their underwriting. To further manage risk, loan payments are direct debited from borrower bank accounts. Direct debit of mortgage payments has also been used with success in some Mexican housing programs. Because of direct debit, the INFONAVIT mortgage program (a state sponsored housing program) has experienced virtually no mortgage default.

*Russia:*

***[Use this section to stimulate a discussion specifically on Russia. What information can be used to replace the lack of loan payment histories for credit assessment? Could we learn anything for other developing economies such as those in Latin America or Asia? What are the legal impediments to the issues outlined above? Has anyone in the class tried to forecast interest rates? ]***

Historical information on credit risk for housing loans in Russia is unlikely to be useful in predicting future level of defaults. In the past, only Sberbank has made loans for housing purchase. These loans were fixed rate instruments with relatively low payment-to-income ratios, made in a very stable economic environment in which, for a variety of reasons, default was difficult or even impossible. However, most of the conditions that discouraged default under the old regime do not exist in the new lending environment.

In theory, a new system of foreclosure laws should help counter balance the risks posed by a volatile economic environment. In practice however these laws are untested, and provide enormous latitude for individual judges' and bailiffs' discretion. Given this lack of historical experience, the uncertainty and instability of the current environment, and banks' lack of experience in market-oriented servicing procedures, bankers should assume a relatively high probability of default and severity of loss to obtain an initial credit risk spread.

Default costs are influenced by several factors:

First is the timing of default. Earlier defaults are more costly for the bank because a larger share of the total value of loan payments is lost and the discount rate (in this example) is lower in earlier years.

Second is the level of interest rates. At the high nominal interest rates that currently exist in Russia, even relatively high default rates have a modest cost to the lender. The present value of the lost payments due to subsequent defaults is relatively small in relation to the total cash flows of the portfolio, because the discount rate in later years is very high.

Credit risk is in part a function of the type of mortgage that is used. Because of its inflationary environment and high interest rates a variable rate, double indexed mortgage instrument (such as the DAIR or the Mexican Double Indexed Mortgage) is most appropriate. It is important to note, however, that there are specific risks associated with this type of mortgage.

First, DAIR loan has significant negative amortization in its early life. The LTV may rise if interest rates rise significantly faster than property prices. Thus the DAIR may have a higher default probability than an amortizing mortgage instrument (e.g., a classic fixed-rate, level payment mortgage or "FRM").

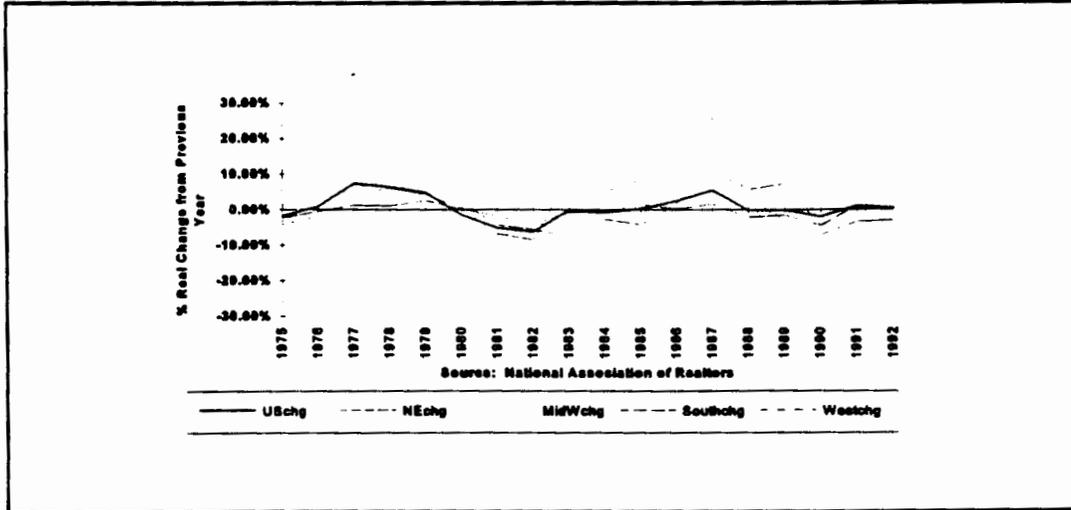
Second, DAIR payments increase in nominal terms over time (but fall rapidly in real terms). Thus, relative to a level payment mortgage there is a greater likelihood of default due to a rising payment-to-income ratio. Although FRM's may have a lower probability of default, such mortgages (as will be shown below) may greatly increase the lender's interest rate risk exposure.

Third, the payment rate on the DAIR will affect credit risk. The higher the payment rate, the more the discounted value of mortgage payments is concentrated in the early years of loan amortization. If, in present value terms, most of the loan is repaid in the first several years of loan repayment, then defaults occurring in later years will have only a relatively small impact on bank profitability.

Because there is no experience with mortgage default in Russia, there is no basis for a specific default probability or severity recommendation. The lender will have to select an initial combination based on its underwriting criteria and market conditions. The premium can be adjusted as conditions change and experience is gained.

***[If a computer lab is available this is a good place to work with the DAIR default risk pricing model. See session A]***

# US. Real House Price Change



## Session 3 Interest-Rate Risk

***Time: 1 hour***

***Format: Lecture and discussion***

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***[Show overhead 13 here]***

*Theory:*

Interest-rate risk relates to the impact that changes in interest rates have on the value of a lending institution's assets, liabilities and income stream.

If a lender's assets and liabilities are perfectly matched (specifically the cash flows are matched) then the value of its assets and liabilities will change by equal amounts as interest rates change, leaving the value of the bank (i.e., the value of shareholder equity) unchanged.

If the lender is not perfectly matched, interest income and expense will change by different amounts as interest rates change, affecting market value and cash flow.

***[Show overhead 14 here]***

***[It might be useful to do the following example on a chalk board or on the overhead. You could turn it into a question and let the class answer it]***

**Example:**

A bank makes a 20 year 10 million Ruble loan at a fixed 100 percent interest rate and its cost of funds is 60 percent. If, at the end of one year the cost of funds has increased to 110 percent, the value of the loan has decreased because its return, while constant in absolute terms, has declined relative to the cost of funds.

A perfectly matched lender can maintain a constant spread as interest rates change.

***[Show overhead 15 here ]***

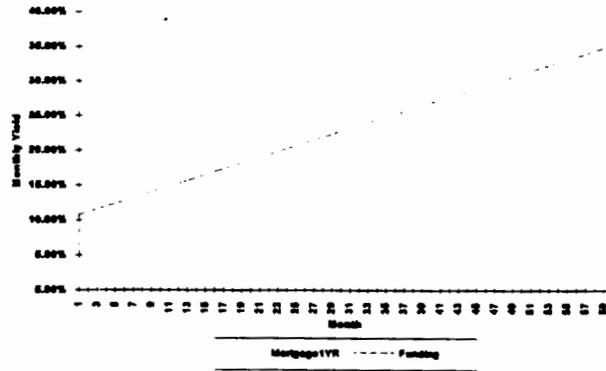
Interest rate risk can occur if the interest rate reset characteristics of the assets do not exactly match those of the liabilities (e.g., the rates of the asset and the liability are adjusted at different intervals or based on the values of different indices).

If the lender adjusts the rate on the loan annually, but funds it with a liability that is repriced monthly, the loan rate may be below the liability rate much of the time in a rising interest rate environment (as depicted in Exhibit 6 with market rates rising at approximately 0.5 percent per month).

An interest rate mismatch also can occur if the liabilities are reset less frequently than the loans. In that situation, the direction of effects in Exhibit 6 are reversed (e.g., net interest spread falls as interest rates fall).

Clip and turn into oh 15

**Mortgage and Borrowing Interest Rates**



In the extreme, a lender granting a loans with a fixed interest rate funded by monthly repricing liabilities can be left with an negative spread in a rising interest rate environment.

***[What might be the effect on an institution's balance sheet and income statement if interest rates are perfectly matched? What might happen if there is a mismatch (both ways)?***

### **Fixed Rate Lending**

***[Show overhead 16 here]***

***Management:***

***[Show overhead 17 here]***

Interest-rate risk is typically managed by the treasury department of a bank, through the pricing and funding of assets purchased or originated.

Interest-rate risk policies are set by an Asset-Liability Committee which reviews periodic reports of the exposure of the institution. Such reports include analysis of the periodic GAP, portfolio duration, mark-to-market and income simulation models.

**Periodic GAP:** The ruble volume of assets that mature or reprice during a given period less the ruble volume of liabilities maturing or repricing during the same period.

**Mark-to-market analysis:** (or market value accounting) is used to estimate the market value of assets and liabilities under different scenarios about the movement of interest rates over time.

**Income analysis simulation:** involves modeling (usually with a computer) the income and expense (and underlying cash flows) of the firm under different interest rate scenarios.

These reports are used by institutions to adjust their funding mix (by maturity) to keep interest rate sensitivity of the portfolio within acceptable limits.

One way of managing interest-rate risk is through matched duration funding. Duration is the weighted average period of time over which the cash flows of an investment are expected to be realized (i.e., time periods are weighted by the volume of cash flows occurring in each period). Matching duration involves simulation of the projected cash flows of assets and funding them with liabilities with similar or identical cash flow characteristics

The interest rates on government securities are used as reference rates as they are the securities with the greatest volume outstanding and the most secondary trading, allowing accurate determination of market value, and are regarded as default risk free. An example of the term structure of interest rates, also referred to as the yield curve, for U.S. government securities is shown in Exhibit 8.

***[Show overhead 18 here]***

**U.S. Treasury Yield Curve (12/92)**

*Western Guidelines:*

Lending institutions in some Western countries (notably the U.S.) have had adverse experience with interest rate risk under conditions of interest rate volatility.

Problems typically arise with the funding of long-term fixed rate mortgages with short-term deposits. During periods of rising short-term rates, the net interest margin (the difference between interest income and interest expense) can become negative and the market value of the mortgages can fall well below the market value of the liabilities.

Interest rate risk soon may become a factor in setting depository institution capital requirements. Both U.S. regulatory agencies and the Bank for International Settlements are considering requirements for lending institutions to have sufficient equity capital to withstand interest rate shocks of certain magnitude (e.g., the change in the value of shareholder equity due to a 200 or 400 basis point increase or decrease in interest rates).

*Russia:*

***[Use this section to stimulate a discussion specifically on Russia. How do class participants manage interest rate risk? What can be a bench mark given the absence of long term government securities? What do other countries do? (Mexico has only a 28 day SETE rate)]***

In an economy lacking a well-developed government securities market (particularly for long term securities) the best strategy for interest rate risk management is avoidance (e.g., investing in floating rate assets funded with floating rate debt). However, interest rate risk arising from differences in the frequency with which asset and liability rates are adjusted can be priced by examining the performance of a portfolio of mortgages under different interest rate scenarios and applying subjective weightings to the possible occurrence of the scenarios.

***[If computer resources are available this is a good place to stop and go work on the DAIR Interest Rate Risk Pricing Model. See Session B]***

## Session 4 Options Risk

*Time: 1 hour*

*Format: Lecture and discussion*

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*[Show overhead 19 here]*

*Theory:*

Mortgages contain options for the borrower and the lender. In general terms an option gives the holder the right but not the obligation to buy or sell a contract at a predetermined price.

There are two basic types of options on the borrower side of a mortgage:

First, the borrower may have the right to prepay the mortgage at a price equal to the outstanding balance. There are, however, some instances in which this right can be precluded. For example, prepayment of fixed-interest mortgages is precluded in Germany.

Second, the borrower has the right to default on the mortgage (in effect selling the house to lender for the outstanding mortgage balance). In some countries, however, lenders retain the right to take legal action against the borrower if the proceeds from the sale of the house are less than the outstanding balance of the mortgage.

Borrower options are typically exercised to the advantage of the borrower and the disadvantage of the lender. Thus, they involve a cost to the lender. The expected cost can be offset by incorporating a yield premium (i.e., an option fee).

*Prepayment risk:*

*[Show overhead 20 here]*

Prepayment risk arises when the interest rate on the loan is fixed for a period of time and borrowers have a right to repay the loan prior to final maturity.

If the market rate falls below the contract rate on the loan, the borrower has an incentive to refinance (i.e., repay the loan with proceeds from a new loan issued at the market rate of interest).

A rational borrower will do so if the gains from a lower interest rate are greater than the transactions cost of refinance. The cost to the lender is the reinvestment of the loan proceeds at the (now lower) market rate.

Because the incentive to prepay the loan depends on current and expected future interest rates, the option to prepay the mortgage is very difficult risk to price. The expected cost of the option depends on the mortgage contract characteristics (i.e., the period during which the rate is fixed and the amortization pattern), and the expected direction and volatility of market rates.

**Aside:**

Technically prepayment is a call option granted by the lender to the borrower allowing the borrower to call (i.e., repay) the loan away from the lender. Default is a put option allowing the borrower to put (i.e., give) the house to the lender (instead of repaying the mortgage). Valuation of mortgages options is very complex because interest rates and mobility behavior must be forecast and the response of borrowers to differentials between contract and market interest rates must be estimated.

A commitment option is granted when the lender commits to lend at a particular interest rate prior to the funding of the loan. It is similar to a prepayment option except that the period during which the option applies is much shorter.

*Western Guidelines:*

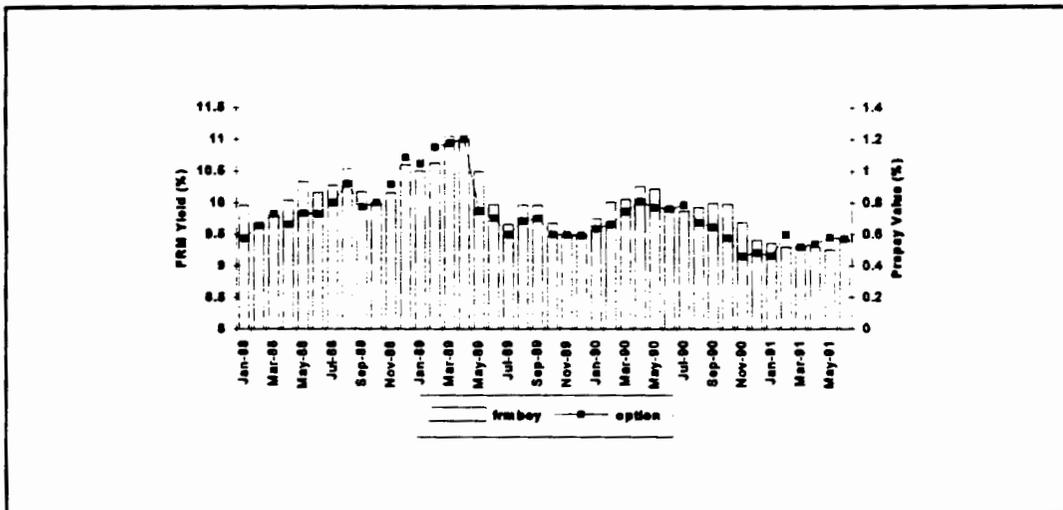
Considerable technology has gone into the pricing of the prepayment option in U.S. fixed-rate mortgages.

**[If the instructor has knowledge of the subject, a discussion on econometric techniques for determining prepayments could go here. The instructor might also talk about the effect prepayments have on mortgage-backed securities.]**

**[Show Overhead 21 here]**

An estimate of the value of the option in the U.S. mortgage market is shown in Exhibit 13. In the U.S., the value of the option during the 1988 to 1991 time period ranged between 50 and 120 basis points. The value of the option varied with the level of rates and their volatility.

#### U.S. Fixed Rate Mortgage Yields and Prepayment Option Values



Source: Diamond & Lea (1992)

*Russia:*

**[Use this section to provide material for a discussion of the issues of options risk in Russia. Given the current inflationary environment, what would the likely prepayment patterns in Russia be? Does an option to default make sense?]**

A prepayment option on a fixed rate mortgage would be impossible to price in Russia because of the extreme uncertainty in the future course of interest rates and the lack of experience with mortgage lending.

Although prepayment can, in theory, be contractually precluded, enforcement of such a provision in Russia would be highly unlikely because of the high level of nominal interest rates. If inflation is reduced in the future and market interest rates fall from current levels to 25 to 30 percent, the bank would have to lower the rates on outstanding mortgages regardless of the contractual provision.

Commitment options are typically granted for 30 to 60 day time periods in the U.S. Although lenders frequently do not charge a fee for a commitment (due to competitive pressure), it does have a cost to the lender. A reasonable estimate for the costs of a 30 day commitment option in the U.S. is one-quarter to one-half of one percent of the loan amount. Because interest rate volatility is much higher in Russia, the cost would be much higher.

## Session 5 Spread Risk

***Time: 1 hour***

***Format: Lecture and discussion***

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***[Show overhead 22 here]***

***Theory:***

Spread risk arises in the course of long-term variable-rate lending when the spread (margin) on the loan is fixed and the spread on the funding is variable.

***[Use the following example in lecture. Turn it into a question and have the class answer it.]***

**Example:**

If a bank makes a 20 year mortgage loan with a yield equal to a fixed spread over the 1 month interbank rate, and funds the loan with a series of 1 month loans at the interbank rate, it is exposed to the risk that the spread it must pay for its money may vary over time.

Changes in funding spreads can take place due to systemic reasons (i.e., general decline in credit quality in the economy) or due to non-systemic reasons (i.e., decline in the relative credit quality of the bank such that it must pay higher interest rates to attract funds than other banks).

***[Show overhead 23 here]***

***Management:***

Spread risk can be managed through the issuance of long maturity, floating rate debt.

*Western Guidelines:*

Even in highly developed financial systems funding spreads can vary across time and quality of issuer. The average spreads on floating rate debt have varied considerably in the U.S. over the past few years. Funding spreads in the U.S. were relatively high in the 1980's but have been extraordinarily low in recent years. The decline since 1988 reflects the slowdown in the economy (and debt issuance) and a greater emphasis on higher quality issuers.

*Russia:*

***[Use this section to provide material for a discussion of the issues of spread risk. IS spread risk in Russia an issue? How might spread risk be priced?]***

Conceptually, spread risk can be priced through time series analysis of the relationship between different classes of debt instruments across economic cycles. In Russia, such information is not likely to be available for a number of years. However, the bank should endeavor to track yields on different securities and loans so the analysis can be done in the future. In the current environment, the bank could encourage long-term variable-rate deposits from enterprises to fund its mortgage loans.

## Session 6

### Liquidity Risk

***Time: 1 hour***

***Format: Lecture and discussion***

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***[Show overhead 24 here]***

***Theory:***

**Liquidity or marketability risk deals with the difficulty in being able to convert assets into cash at or near their market prices (e.g., to meet deposit outflows).**

**For tradable assets (i.e., securities) marketability risk can be expressed in terms of the difference between the bid and the ask price for the asset.**

**The bid price is the price that a willing buyer would pay for the asset. The ask price is the price at which a seller would be willing to sell.**

**An alternative to selling an asset to raise cash is to use it as collateral in obtaining a loan from another financial institution (or to back a line of credit used on a stand-by or as-needed basis).**

**Depository institutions are generally required to hold reserves at central banks to facilitate the operation of monetary policy and to help assure that sufficient funds are available to meet deposit outflows.**

***[Show overhead 25 here]***

**Some Countries Requiring Reserves:**

France

Germany (6-12% of timed accounts)

Italy (only country to pay interest on reserves)

Japan

Netherlands

Switzerland

UK

USA (3% of transaction accounts and timed deposits)

**No Reserve Requirements:**

Belgium

Canada

Lending institutions also hold cash and short-term securities called liquidity portfolios to manage short term cash flow fluctuations. Liquidity portfolios and reserves have relatively low interest rates and therefore involve an opportunity cost to the lender.

***Management:***

Requirements for liquidity management:

First, it involves detailed cash flow projections to determine the bank's likely cash needs.

Second, it involves developing a liquidity strategy for raising cash, identifying sources and costs.

***[Show overhead 26 here]***

Developed country financial institutions use a variety of funding sources to manage their cash needs. These include:

- Asset sales
- Maintenance of liquidity portfolios
- Deposits
- Collateralized and uncollateralized borrowing
- Stand-by lines of credit
- Eligibility to borrow from the Central Bank

Diversification of funding sources can reduce the cost and risk of asset illiquidity.

***Western Guidelines:***

Reserve requirements vary considerably across countries. Formal levels range from zero in several countries (e.g., Belgium and Canada) to 6.6 percent of demand deposits and 4 to 5 percent of time deposits in Germany.

Liquidity requirements vary across country and type of institution but are typically in the range of 5 to 15 percent of assets. Such

requirements are frequently informal (i.e., subject to regulatory discretion) and related to interest-rate risk exposure (e.g., an institution may be warned to increase liquidity when it has a significant excess of short-term liabilities over short-term assets).

Several countries (e.g., France, Italy and Germany) have detailed requirements limiting exposure to long-term loans and investments.

The cost of reserves at different reserve requirements and interest rates can be calculated using the following formula:

***[Show overhead 27 here]***

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(1) Liquidity Risk Spread =  $\{(LR - RR)/(1 - CBR)\} - LR$  where

LR = Loan Rate (or targeted yield on assets)

RR = Rate paid by Central Bank on reserves

CBR = Central Bank reserve requirement

---

Because mortgages are generally illiquid assets, specialized lending institutions have been created to refinance mortgage portfolios in several countries. These institutions typically issue unsecured government guaranteed or supported debt in the capital markets and related to mortgage institutions on a collateralized basis.

***[Use the following example if there is time]***

---

**Example:**

The Federal Home Loan Banks in the U.S., the Landesbanken in Germany and the Caisse de Refinancement de Hypothecaire in France. The Federal Home Loan Banks were created in the Depression to encourage savings institutions to make long-term amortizing mortgages (prior to the Depression only 5 to 7 year bullet loans (interest only) were widely available). Specialized mortgage lenders in Europe were created to channel long-term savings (e.g., from insurance contracts and pension funds) to housing allowing depository institutions (with predominately short-term deposits) to concentrate on short-term commercial lending (particularly during the post-War period).

---

**Russia:**

***[Use the following section to start a discussion on issues of liquidity in Russia. What are the risks in Russia today? What is the current central bank reserve requirement? What alternatives do Russian banks have for obtaining liquidity? Are commodity back bonds a feasible answer? Are deposits realistic?]***

Until financial markets develop in Russia, liquidity risk may represent the major risk associated with mortgage lending. As options develop for consumer and enterprise savings, Russian banks will be exposed to the risk of significant deposit outflows.

Competition will eventually force interest rates to be positive in real terms, a necessary though not sufficient requisite for financial system stability. Banks that fail to provide competitively priced investments for their customers will be exposed to significant liquidity risk.

Perhaps reflecting this risk, the Central Bank reserve requirement against loans is 20 percent, a relatively high requirement. For

commercial banks. Sberbank has a reserve requirement of 15 percent against long term (over 1 year) deposits and 20 percent against short term deposits.

The opportunity cost of these reserves represents the main cost of liquidity in Russia. This cost must be included in the mortgage rate or deducted from deposit rates. Because reserves primarily benefit depositors (helping to ensure the availability of funds to meet withdrawals) it may be more appropriate to allocate them to deposits. Doing so would be consistent with the observation that deposit rates in Russia are significantly below market and banks generate a significant proportion of their profits through accumulation of below market funds in their branch systems.

Current commercial bank reserve requirements of 20 percent of outstanding loan balances, with a 150 percent annual loan rate, a zero interest rate on reserves and 50 percent of assets held in the form of loans, would necessitate a liquidity risk spread of 18.75 percentage points to compensate the lender for the lost earnings of the non-interest bearing deposits.

If the liquidity risk premium is obtained only from loans, the required spread would be 37.5 percentage points. For variable-rate loans, the loan rate should be the average rate expected over the life of the loan. The DAIR poses a significantly greater liquidity risk for lenders than other types of loans. In an inflationary environment, the outstanding balance for the DAIR rises significantly during the early years of the loan life. To offset a cash flow mismatch (i.e., that arising from having to pay depositors interest without receiving interest payments from borrowers) the bank will have to reduce its cash balances or issue new liabilities.

In a high inflation environment, the outstanding balance on a DAIR can become several hundred times the initial balance. Thus, until inflation returns to moderate levels, only a small proportion of assets should be invested in DAIR or other deferred payment loans.

The current application of reserve requirements on outstanding loan balances means that the volume of reserves held against a given DAIR

loan would increase significantly over time and the opportunity cost of holding these reserves would also rise. However, if the interest payments to fund the DAIR are obtained by decreasing cash balances, then the growth in loan balances will not require increases in outstanding liabilities. In this case, if the reserve requirement is imposed on liabilities instead of loans, the opportunity cost of holding reserves will not increase as the loan balance rises.

An alternative approach to managing the liquidity risk of DAIR loans is to establish a liquidity facility (i.e., Agency for Mortgage Finance) which could purchase the loans or the future cash flows arising from negative amortization. This agency could fund its purchases with bond issues. In a start-up phase, the agency could issue zero-coupon bonds (thus avoiding the cash flow mismatch problem). Once the Agency accumulates a portfolio of amortizing mortgages or payment streams, it could begin issuing interest paying securities.

In order to enhance the attractiveness of these bonds, they could be guaranteed for some finite period after creation of the Agency (e.g., until a cash flow balance was achieved). At that time the guarantee could be withdrawn. The French government followed this strategy when it created the Caisse de Refinancement de Hypothecaire. An obvious danger of creating an agency that can issue government guaranteed debt is that it can distort the market (e.g., by underpricing mortgages and discouraging private investment).

## Session 7

### Operating Costs

***Time: 1 hour***

***Format: Lecture and discussion***

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***[Show overhead 28 here]***

***Theory:***

The cost of obtaining funds, originating mortgages and servicing mortgages needs to be considered in mortgage pricing. The appropriate costs are the marginal costs of originating, funding and servicing mortgage loans.

The fixed costs of running branch systems and/or developing the systems necessary to originate mortgages must also be accounted. These costs can be spread out over time (in line with the depreciation of systems, branches and customer relationships) and apportioned between a bank's savings and borrowing customers.

***Management:***

It is important to develop management information systems that will allow the lending institution to determine the costs of different functions associated with the lending process. Such information is necessary to effectively manage resources and determine which functional activities and lines of business are most profitable. This type of analysis has only recently been introduced in Western lending institutions.

***Western Guidelines:***

***[Show overhead 29 here]***

There are two major forms of funding for mortgages in Western housing finance systems: deposits and capital markets.

Commercial banks and savings institutions have historically relied on deposits.

Specialized mortgage lending institutions (mortgage banks or wholesale lenders) rely on the issuance of securities (mortgage bonds) for their funds.

Wholesale-funded lenders are typically more efficient than depositories, as evidenced by lower average costs of operation.

*[Show overhead 30 here]*

### Average 1990 Operating Costs of Mortgage Lenders

| Country        | Lender                  | Average Cost (% of Assets) |
|----------------|-------------------------|----------------------------|
| Denmark        | Mortgage Banks          | 22 bp                      |
|                | Depository Institutions | 189 bp                     |
| France         | Mortgage Banks          | 150 bp                     |
|                | Depository Institutions | 250 bp                     |
| Germany        | Mortgage Banks          | 23 bp                      |
|                | Depository Institutions | 210 bp                     |
| United Kingdom | Centralized Lenders     | 25 bp                      |
|                | Building Societies      | 116 bp                     |
| United States  | Mortgage Banks          | 27 bp                      |
|                | Thrift Institutions     | 221 bp                     |

Source: Diamond & Lea (1992)

The average costs in Exhibit 15 include:

- Costs of originating,
- Servicing and funding loans (and securities)
- Institutional overhead such as:
  - Human resources
  - Executive management,
  - Accounting
  - Legal systems
  - Staff

The higher average costs of depository institutions reflects the use of branch systems to gather funds (typically at below-market rates) and a

more diverse mix of activities (e.g., mortgage, consumer and commercial lending).

Wholesale funded institutions lack the high fixed costs of depository institutions (particularly the deposit-taking branches). Thus their marginal costs are likely to be close to their average costs shown in Exhibit 15.

Depository institutions offset their higher average costs of operation through obtaining deposits at below-market (e.g., relative to government securities) rates and selling a number of services (e.g., insurance, safe deposit boxes) to their customers on a fee basis. Their ability to obtain deposits at below market rates depends on the alternatives available to depositors and the value they place on savings through depository institutions (e.g., convenience, small denomination accounts, safety).

*Russia:*

***[Use this section to start a discussion on the issues of operating costs in Russia. What effect does inflation have on operating costs? How could a bank minimize the impact of inflation on servicing mortgage loans?]***

The lack of Western style accounting systems makes cost comparisons between Western and Russian banks difficult. In addition, the mortgage operations of Russian banks are in the formative stage and have not achieved the scale economies of their Western counterparts. Initially, the banks could estimate the labor costs (the major variable cost) of mortgage lending and servicing and calculate a ratio of these costs to expected loan balances.

An additional problem in pricing operating costs in Russia is inflation. Operating costs are likely to rise over time at a rate at least equal to average wage inflation. If a fixed interest rate spread is assigned to cover this cost, the nominal amount the bank receives from the operating cost spread will increase at roughly the inter-bank lending rate for the DAIR (until the later years of the loan life when the outstanding balance begins falling sharply). Alternatively, for a level payment mortgage the real value of the operating cost spread could fall sharply over time. In either case, at some future date, the funds

from this spread will be inadequate to cover the bank's servicing costs.

To address this problem, the bank could price origination and servicing costs as fees to the borrower. Because origination and servicing costs are independent of loan size, these fees should also be independent of the size of the loan. An origination fee to cover all bank costs associated with underwriting and closing the loan could be charged at the time a loan is funded (similar to the U.S. system). A servicing fee could be charged on an annual basis and indexed to inflation or wage rates (i.e., a measure external to the bank).

**Example:**

If in December 1994, a bank estimated that in 1995 its cost of servicing loans would be Rb. 5,000 per loan, then each borrower could be assessed this fee. If 1995 wages increased by 150 percent, then the bank could charge each customer a fee of Rb. 12,500 for servicing costs in 1996.

## Session 8 Profit Spread

***Time: 1 hour***

***Format: Lecture and discussion***

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***[Show overhead 31 here]***

***Theory:***

Financial institutions use a mix of debt and equity to fund assets. Equity investors (shareholders) typically receive returns (or profits) after depositors and secured lenders receive interest payments and employees are paid. Equity investors also stand last in line to receive the proceeds of liquidation of a firm. As such, capital is the riskiest form of investment and investors require higher returns than depositors and secured lenders.

Market returns to equity investment will be determined by the marginal productivity of capital in the economy. The cost of equity for a particular investment will depend on its relative risk.

In efficient markets, the return of a stock can be measured in terms of its risk (variability in returns) relative to the market portfolio (variability of the market as a whole). This approach is referred to as the capital-asset pricing model.

Conceptually, the expected return on equity investment can be thought of as the investor's required risk premium over a market benchmark (e.g., the risk-free rate). Returns can be paid out in the form of dividends or retained by the bank.

***Western Guidelines:***

Because financial institutions are regulated and primarily engaged in lending as opposed to equity investment, they exhibit less variability in returns and thus require a lower risk premium than most other firms.

In recent years, profitable banks in developed financial systems have earned after-tax spreads of 300 to 400 basis points over intermediate term government securities. The 1992 U.S. average after-tax return on equity for commercial banks was approximately 13 percent and that for savings institutions was approximately 10 percent. The inflation rate was approximately 4 percent and the average tax rate was approximately 25 percent.

**Russia:**

Per discussions with Russian banks, the equity weight is assumed to be 5 percent and the debt weight is assumed to be 95 percent. The cost of debt is assumed to be the interbank lending rate. The cost of equity can be assumed to be a spread over the interbank rate, depending on investor requirements. The profit spread can be expressed as:

***[Show overhead 32 here]***

$$(2) \quad \text{Profit Spread} = (\text{Equity}/\text{Assets})(R_s - R_d)$$

where

$R_s$  = Return to shareholders

$R_d$  = Return to depositors (e.g., interbank rate)

Thus, if the shareholders require 140 percent when the interbank rate is 120 percent, the profit spread would be 1 percent. This profit spread is applied to the entire portfolio.

## Session 9

### Mortgage Pricing- Putting it all Together

*Time: 1 hour* *Format: Lecture and discussion*

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**[Show overhead 33 here]**

**Theory:** The price of an asset such a mortgage loan can be thought of as the sum of the weighted average cost of capital and the expected costs associated with funding, servicing and investment. The weighted average cost of capital reflects the required returns to the bank's debt holders (depositors) and equity investors (shareholder). A general formulation follows that can accommodate different benchmark rates and separate spreads to the benchmark rate for debt and equity holders. The yield can be expressed as follows:

$$(3) \quad \text{MORT} = \text{DY}(\text{D/A}) + \text{EY}(\text{E/A}) + \text{SPREAD}$$

where

MORT = Mortgage lending rate

DY = Debt Rate (spread over benchmark rate for depositors)

EY = Equity Rate (spread over benchmark rate for shareholders, or profit spread)

E/A = Equity to Assets Ratio

SPREAD = Expected cost and risk adjustments

**[Show overhead 34 here]**

$$(4) \quad \text{SPREAD} = \text{CR} + \text{IRR} + \text{BR} + \text{OR} + \text{LR} + \text{AC}$$

where

CR = Credit risk premium

IRR = Interest rate risk premium

BR = spread risk premium

OR = Options risk premium

LR = Liquidity risk premium

AC = Marginal operating cost

In a simplified form, the weighted average cost of capital can be expressed as the sum of the benchmark rate and the profit spread. The break-even risk adjusted mortgage yield formulation is shown in Exhibit 16:

***[This is a good exercise to do on the overhead or the chalk board]***

### The Break-even Risk Adjusted Yield

| Component                                       | Cost  |
|---|-------|
| (1) Benchmark (Interbank) Rate                  | 130.0 |
| (2) Bank Borrowing Spread*Debt Weight           | 0.0   |
| (3) Equity Funding (Profit)Spread*Equity Weight | 2.0   |
| (A) WEIGHTED COST OF CAPITAL (1+2+3)            | 132.0 |
| (4) Credit Risk                                 | 2.5   |
| (5) Interest-rate Risk                          | 0.0   |
| (6) Spread Risk                                 | NA    |
| (7) Liquidity Risk                              | 20.5  |
| (8) Options Risk                                | NA    |
| (9) Administrative Cost                         | 6.0   |
| (B) SPREAD (4+5+6+7+8+9)                        | 29.0  |
| ☉ BREAK-EVEN RISK ADJUSTED YIELD<br>(A+B)       | 161.0 |

## Session 10

### Course Summary

***Time: 30 Minutes***

***Format: Discussion***

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Use the final minutes of the class to do the following:

1. Recap the components to mortgage pricing:

- **Credit Risk** - Potential loss due to borrower default;
- **Interest Rate Risk** - Potential loss deriving from mismatched funding (e.g., if loan rates adjust less frequently than funding rates in a rising interest rate environment);
- **Options Risk** - Reinvestment loss due to early redemption of fixed-rate mortgages (prepayment risk) and funding loss associated with locking a rate to a borrower prior to funding (commitment risk). These costs can be zero if prepayment is precluded, the mortgage rate is not fixed, or rates are not locked until funding;
- **Spread Risk** - Potential loss deriving from change in funding margin (relative to a reference rate) if lending with a fixed margin (relative to a reference rate);
- **Liquidity (Marketability) Risk** - Cost of maintaining reserves or lines of credit, or losses associated with the sale of assets to raise cash;
- **Administrative Cost** - Marginal cost of raising funds, originating mortgages and servicing mortgages;
- **Profit Spread** - The targeted return on shareholder investment, net of expected losses and costs, necessary to compensate investors for the uncertainty of cost and loss estimates (e.g., through increased volatility in interest rates) and the opportunity cost of their investment.

Finally, turn this into a question and answer session. Use the time to see if there are any questions. If the class is silent, pose questions from the material covered in the course.

## Session A DAIR Default Risk Pricing Model

**Time: 1-2 hours (depending on time availability) Format: Computer Lab**

It is suggested that the instructor do the following to prepare for the computer lab:

1. Study the computer model thoroughly.
2. If necessary, refer to the user guide in Lea and Ravicz, pages 44-52.
3. Make sure each computer workstation has a working copy of the model on it.

A suggested format of the computer lab is as follows:

1. Demonstrate how to start the model.
2. Systematically describe the model- describe each logical section, its inputs, its outputs and the calculations.
3. Let the students play with the model for 5-10 minutes.
4. Prepare an example, such as the following, and have the class work through it.

### **Sample DAIR- Default Risk Exercises**

1. For this exercise, use the DAIR default risk model to fill in the blank boxes in the following table. The purpose of this exercise is twofold. First, it provides practice with the mechanics of the model. Second, it demonstrates how the combination of the borrower interest rate (pay rate) and the loan default rate affect the price of a mortgage. You will need to change two parameters.

**Table 1**

| Borrower |     | % of Loan Defaulting |     |     |     |
|----------|-----|----------------------|-----|-----|-----|
|          |     | 0%                   | 10% | 20% | 50% |
| Pay      | 5%  |                      |     |     |     |
| Rate     | 10% |                      |     |     |     |
|          | 20% |                      |     |     |     |

2. For this exercise use the DAIR default risk model to fill in the blank boxes in the following table. You will only need to change one parameter.

**Table 2**

| Borrower |     | Present Value |             |             |
|----------|-----|---------------|-------------|-------------|
|          |     | 1st 5 Years   | 2nd 5 Years | 3rd 5 Years |
| Pay      | 7%  |               |             |             |
| Rate     | 12% |               |             |             |
|          | 24% |               |             |             |

3. Defaults often rise when interest rates rise. In table 3 interest rates decline for 6 year but then rise for 6 years before finally falling again. Simultaneously, mortgage defaults rise with the rise in interest rates. Use the values in the table to see the affect on the price of a mortgage- fill in

table 4

| Month | IB Rate | % of Default |
|-------|---------|--------------|
| 1     | 250     | 0.0          |
| 2     | 240     | 12.5         |
| 3     | 220     | 12.5         |
| 4     | 200     | 15.0         |
| 5     | 180     | 5.0          |
| 6     | 170     | 0.0          |
| 7     | 190     | 0.0          |
| 8     | 200     | 0.0          |
| 9     | 210     | 0.0          |
| 10    | 230     | 10.0         |
| 11    | 240     | 15.0         |
| 12    | 280     | 20.0         |
| 13    | 170     | 10.0         |
| 14    | 160     | 0.0          |
| 15    | 140     | 0.0          |
| 16    | 110     | 0.0          |
| 17    | 90      | 0.0          |
| 18    | 85      | 0.0          |
| 19    | 80      | 0.0          |
| 20    | 70      | 0.0          |
| 21    | 60      | 0.0          |

**Table 3**

**Table 4**

| Borrower | Pay Rate | Present Value |             |             |
|----------|----------|---------------|-------------|-------------|
|          |          | 1st 5 Years   | 2nd 5 Years | 3rd 5 Years |
|          | 7%       |               |             |             |
|          | 12%      |               |             |             |
|          | 24%      |               |             |             |

## Session B

### DAIR Interest Rate Risk Pricing Model

**Time: 1-2 hours (depending on time availability)      Format: Computer Lab**

It is suggested that the instructor do the following to prepare for the computer lab:

1. Study the computer model thoroughly.
  
2. If necessary, refer to the user guide in Lea and Ravicz, pages 53-61.
  
3. Make sure each computer workstation has a working copy of the model on it.

A suggested format of the computer lab is as follows:

1. Demonstrate how to start the model.
2. Systematically describe the model- describe each logical section, its inputs, its outputs and the calculations.
3. Let the students play with the model for 5-10 minutes.
4. Prepare an example, such as the following, and have the class work through it.

***[The following is an example of what could be done in the computer lab to demonstrate interest rate risk pricing.]***

#### **Interest-Rate Risk Pricing Net Interest Spread Sensitivity**

##### **Mismatch**

| Interest-Rate Scenario | 1 Mo-1 Mo | 3 Mo-1 Mo | 6 Mo-1 Mo | 12 Mo-1 Mo | 60 Mo- 1 Mo |
|------------------------|-----------|-----------|-----------|------------|-------------|
| Constant               | 5.0       | 5.0       | 5.0       | 5.0        | 5.0         |
| Up 0.5% per month      | 5.0       | 2.85      | <15.63>   | <33.37>    | <175.96>    |
| Up 1% per month        | 5.0       | 0.79      | <35.57>   | <70.54>    | <353.01>    |
| Down 0.5% per Month    | 5.0       | 8.95      | 12.27     | 19.5       | 106.36      |

**Assumptions:**

-Net Interest Spread = (Interest Income - Interest Expense)/Avg. Assets; Rub. 10 billion variable-rate interest-only mortgage portfolio (no principal is assumed to be repaid over the period examined); Initial mortgage rate: 129%; Initial funding rate: 124%; Market rate changes monthly for the first 5 years; Leverage Ratio: 100% debt, 0% equity; Down Scenarios subject to annual interest rate floors of 7.5% mortgage and 2.5% liability rates.

-Asset-Liability repricing frequency (e.g., "3 Mo - 1 Mo" means that assets reprice every 3 months and liabilities reprice every month).

-Mortgages are assumed to be interest only (no amortization) and funded completely with debt (e.g., interbank loan).

In the above example, the annual average net interest spread (interest income less interest expense divided by average assets) of the mortgage portfolio is calculated under different interest rate and reset frequency assumptions. The column headings represent different asset-liability reset mismatches. The row headings contain assumptions about monthly interest-rate change (in percentage points).

With a matched portfolio (i.e., one in which asset and liability rates change with the same frequency), the annual average net interest spread is a constant 5 percent as interest rates increase and decrease. The net interest spread declines with greater mismatches in a rising interest rate environment (because the liability rate is rising on a monthly basis and the asset rate rises with a lag). With an increase of 50 basis points per month during the 60 month time horizon in this example (mortgage rate rising to 447 percent) the annual average net spread becomes negative with a 6 month to 1 month reset mismatch (annual average interest expense is greater than annual average interest earned). The opposite is true in a falling rate environment as the net interest spread rises with greater mismatches. However, with large monthly changes in interest rates, the effect is moderated as rates approach floor (i.e., non-negative) values.

Increasing the bank's leverage (i.e., its ratio of debt to equity) will significantly increase the magnitudes of the net interest spreads shown, because the bank is not required to pay interest to shareholders so its interest expenses are reduced. For a leverage of 95 percent debt and 5 percent equity, the annual average net interest spread in the constant interest rate scenario rises from 5 to 11 percent, as the differential reflecting leverage is compounded.

A theoretical price (interest rate risk premium) for a mismatched funding strategy can be estimated by attaching probabilities to different interest rate scenarios.

**Sample Exercises:**

1. Given that assets re-price every 6 months and liabilities re-price every 12 months, find the spread that will compensate for the resulting mismatch if:
  - a. The borrower pay rate is 10%
  - b. The borrower pay rate is 15%
  - c. The borrower pay rate is 20%
  
2. Given that assets re-price every 2 months and liabilities re-price every 6 months, find the spread that will compensate for the resulting mismatch if:
  - a. The borrower pay rate is 7%
  - b. The borrower pay rate is 12%
  - c. The borrower pay rate is 24%
  
3. Given that both assets and liabilities re-price every month, find the spread that will compensate for the resulting mismatch if:
  - a. The borrower payment adjusts every 12 months.
  - b. The borrower payment adjusts every 6 months.
  - c. The borrower payment adjusts every month.

## **Exams and Exercises**

### **Mortgage Pricing Exercises**

1. If the value of a home is 66 million rubles and the mortgage balance is 50 million rubles calculate the loan-to-value ratio for this mortgage.

- $50/66 = .758$  or 75.8%

2. If the value of a home is 55 million rubles and the mortgage balance is 57 million rubles calculate the loan-to-value ratio for the mortgage.

- $57/55 = 1.036$  or 103.6%

Note that high LTV ratios, particularly those greater than 1.0 or 100% are extremely risky for the institution.

3. A loan underwriter is in the process of qualifying a buyer for a mortgage. The required loan-to-value ratio is 80%. If the price of the house is 24 million rubles, what is the maximum mortgage that can be given? If the person obtaining the mortgage earns 400,000 rubles per month and the maximum payment to income ratio is 30% (pre tax), what is the maximum monthly mortgage payment?

- $x/24 = .80$

$$x = .8 \times 24$$

$$x = 19.2 \text{ million rubles}$$

- $\text{pmt}/400,000 = .30$

$$\text{pmt} = 400,000 \times .30$$

$$\text{pmt} = 120,000 \text{ rubles}$$

4. If the current rate on a mortgage is 130% per year and the monthly rate of the funding instrument (a deposit) is 10%, what is the annual spread between the mortgage and deposit rates?

- Annual rate on the deposit will be  $10\% \times 12 = 120\%$

$$\text{spread} = \text{mortgage rate} - \text{deposit rate}$$

$$\text{spread} = 130\% - 120\% = 10\%$$

5. If the commercial bank reserve requirement is 20%, what is the liquidity risk spread if the targeted return is 160% per year, and the rate paid by the Central Bank on reserves is 0%? What would the liquidity risk spread be if the Central Bank paid 5% per month on reserves?

- Liquidity Risk Spread =  
 $\{(\text{loan rate} - \text{reserve rate}) / (1 - \text{reserve requirement})\} - \text{loan rate}$   
 $\{(160\% - 0) / (1 - 20\%)\} - 160\% = 50\%$

- $\{(160\% - 5\%) / (1 - 20\%)\} - 160\% = 33.75\%$

6. A commercial bank ties the servicing fee it charges to the annual increase in wages. On December 31, 1993 it estimates that it will cost 190,000 Rubles to service a loan for one year. If in 1994 wages increased by 150%, what would the new servicing cost per loan be in 1995?

- New servicing fee =  $190,000 \times 1.5 = 285,000$

7. In bank X, debt weight is assumed to be 95% of assets and equity weight is assumed to be 5% of assets. If the shareholders of the bank require a 155% annual return and the Interbank lending rate is 132% per year, what is the profit spread? What is the profit spread if the Interbank lending rate rises to 140% per year?

- Profit spread = (equity / assets) x (return to shareholders - return to depositors)

- profit spread =  $(5/100) \times (155\% - 132\%)$   
 $= .05 \times 23\% = .0115$  or 1.15%

- profit spread =  $(5/100) \times (155\% - 140\%)$   
 $= .05 \times 15\% = .0075$  or .75%

8. A financial analyst wants to price a mortgage. He knows the following information:

Credit Risk Premium = 2%

Interbank lending rate = 10% per month

Liability spread = 0%

Profit Spread = 1.5% per year

Interest Rate Risk = .9% per year

Liquidity Risk = 22% per year

Administrative Costs = 7% per year

Inflation Rate = 23% per month

What interest rate does he calculate for this mortgage?

- mortgage price = credit risk premium + interbank lending rate + liability spread + profit spread + interest rate risk spread + liquidity risk spread + administrative costs.

mortgage price = 2% + (10% x 12) + 0% + 1.5% + .9% + 22% + 7% = 153.4% / year

Note that inflation is not used in this calculation!

If the inflation rate drops to 12% per month and the Interbank lending rate rises to 12% per month, what would be the interest rate for the mortgage?

- mortgage price = 2% + (12% x 12) + 0% + 1.5% + .9% + 22% + 7% = 177.4% / year

**Mortgage Pricing in Russia Unit  
Exam Questions**

Please explain your answers in detail.

1. The two main factors underlying mortgage default are the borrower's ability to pay his mortgage and the borrower's willingness to pay his mortgage.

a. What determines willingness to pay? What resources (e.g., institutions, protocols) would a loan underwriter need to determine willingness to pay?

- Willingness to pay is determined by the relationship between the market value of the mortgage and the market value of the property. Verification of home value- before the underwriting of a loan- is important for determining willingness to pay. In most developed housing markets, underwriters are aided by third party agencies called multiple listing services. These services keep information on home sale prices so that a proper valuation can be made.

b. What determines ability to pay? What resources (e.g., institutions, protocols) would a loan underwriter need to determine willingness to pay?

- Ability to pay is determined by the relationship between the borrower's income and the mortgage payment. Sound underwriting practices are needed for a lender to determine a potential borrower's ability to pay. Some underwriting protocols would include income verification and verification of outstanding debt and previous credit payment history. In most developed housing markets the underwriter is aided by third party credit bureaus for verifying credit history.

2. A significant feature of the DAIR loan is that it can severely negatively amortize. What effect does this negative amortization have on the credit risk of the borrower?

What are the potential effects of negative amortization on the institution?

- Negative amortization increases the probability of loan default, thus increasing the credit risk of the borrower. Negative amortization can wipe out the equity a borrower has in his/her home. If, for example, the borrower needs to sell the home and the loan has recapitalized to the point that the market value is less than the outstanding loan balance, then loan default is likely. Also, in a DAIR loan, if wages do not keep pace with periodic increases in the mortgage payment, the re-capitalization of the loan can result in a payment that is unaffordable and the borrower defaults.

- From an institutional perspective, credit risk of the borrower is an issue. Also, the build-up of principal resulting from negatively amortizing loans represents a potential liability to the bank. It is recorded on the bank financial statements but, without special legal provisions, this "income" may be taxed.

**3. What is an interest rate mismatch? Why would an interest rate mismatch occur? What are the implications of an interest rate mismatch on a financial institution?**

- Interest rate mismatch is the situation where the interest rate paid on a funding source for a mortgage (e.g., deposits) is higher than the interest rate on the mortgage.
- A mismatch could occur if the mortgage instrument has a fixed interest rate but the funding instrument has a variable rate. Thus, when interest rates increase, the deposit rate could increase to a rate higher than the mortgage rate. Mismatch could also occur when both the mortgage and the funding instrument are variable but the timing of the rate increases is different. For example, in an increasing interest rate scenario, if the timing of the increase of the mortgage rate is slower than the timing of the increase of the deposit rate, then there will be periods of time where the spread is negative.

**4. If prepayment of a mortgage is allowed, what would give a borrower the incentive to prepay his mortgage? How do prepayments affect the financial institution?**

- Prepayment of a mortgage would occur in situations of declining interest rates. A mortgagor might want to "shop around" for a new, lower price mortgage. If he/she finds one, then the old mortgage would be repaid and a new mortgage financed. Prepays are much more common if the interest rate on a mortgage is fixed, though if spreads on variable rate mortgages are not competitive then they are subject to greater prepay rates too.
- Prepayments on fixed rate mortgages present a potential risk to banks. If the prepay occurs in a declining interest rate environment, the bank stands to lose revenue- particularly if the mortgagor find a new mortgage with a different institution. Mortgage prepayment can also present special problems if the mortgage is used as collateral in a mortgage security.

**5. Explain the concept of "spread risk." What causes changes in funding spreads? How can spread risk be managed in Russia?**

- Spread risk arises in the course of long-term variable-rate lending when the spread (margin) on the loan is fixed and the spread on the funding source is variable.

- Changes in funding spreads can take place as a result of systemic factors such as a general decline in credit quality in the economy. Changes in funding spreads can also take place as a result of non-systemic factors such as a decline in the relative credit quality of a bank such that it must pay higher interest rates than other banks to attract funds.

- Spread risk can be managed through the issuance of long maturity, floating rate debt.

## **References**

Lea, M.J. and R.M. Ravicz, "Mortgage Pricing in Russia: A Methodological Introduction," The Urban Institute project 6306-05, July 1993.

Diamond, D.B. and M.J. Lea, "Housing Finance in Developed Countries: An International Comparison of Efficiency," *Journal of Housing Research*, 3, 1, 1992.

Ravicz, R.M. and R. Struyk, "Product Description for the Deferred Adjustable Instrument for Russia," The Urban Institute, March 1993.

Clauretje, T.M. and J.R. Webb, *The Theory and Practice of Real Estate Finance*. (Fort Worth, Texas: The Dryden Press, 1993)

# Basics of Mortgage Pricing

**Instructor:**

**Place:**

**Date:**

# Schedule

Day 1: Introduction

Credit Risk

Interest Rate Risk

Options Risk

Spread Risk

Day 2: Pricing Risk, cont.

Liquidity Risk

Operating Costs

Summary

Exam

Delivery of Certificates

# Risk Components of Mortgage Price

- Credit Risk
- Interest-Rate Risk
- Spread Risk
- Liquidity Risk
- Options Risk

# Additional Components of Mortgage Price

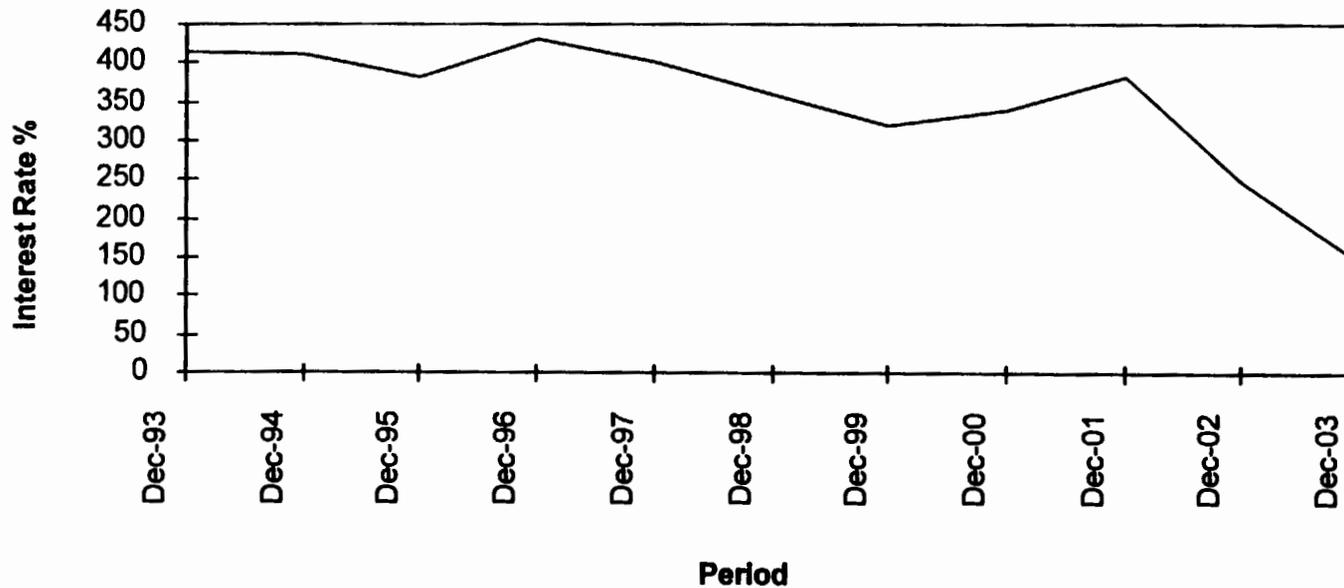
- Base Funding Rate
- Administrative Costs
- Profit

# Mortgage Yield

$$\text{Yield} = \text{Risk Spread} + \text{Administrative Cost Spread} + \text{Profit Spread}$$

# Interbank Interest Rate- Russia

Actual Through 1994- Optimistic Forecast 1995-2003



# Causes of Credit Risk/Default Risk

- **Systemic:** Macro-economic and macro-social factors. Typically affects total bank portfolio.
- **Non-Systemic:** individual borrower or property specific.

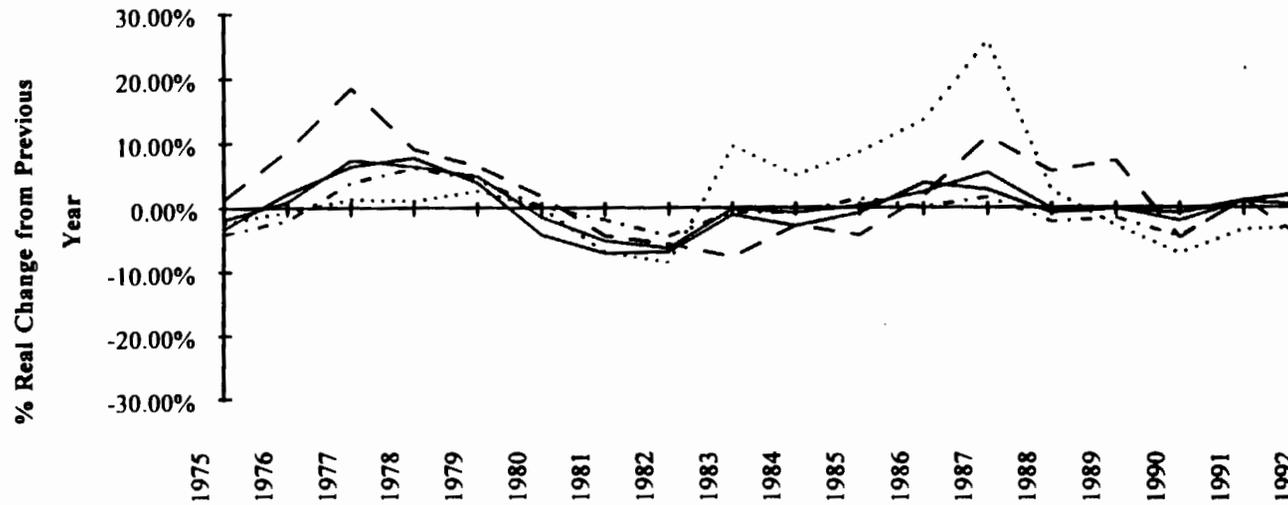
# Institutional Costs of Loan Default

- Loss from sale of repossessed house.
- Administrative costs.
- Maintenance costs on repossessed property.
- Lost interest from loan restructure.
- Time necessary to repossess property.

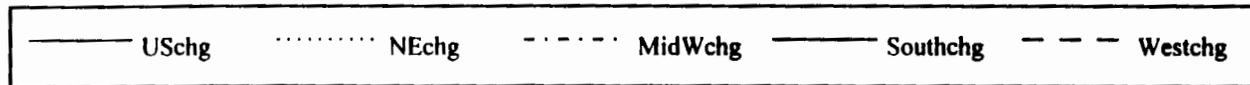
# Management of Credit Risk

- Determination of ability-to-pay.
- Determination of willingness-to-pay.
- Appropriate pricing of interest rate.
- Geographic diversification.
- Development of robust mortgage instruments.

# USA- Geographic Diversification



Source: National Association of Realtors



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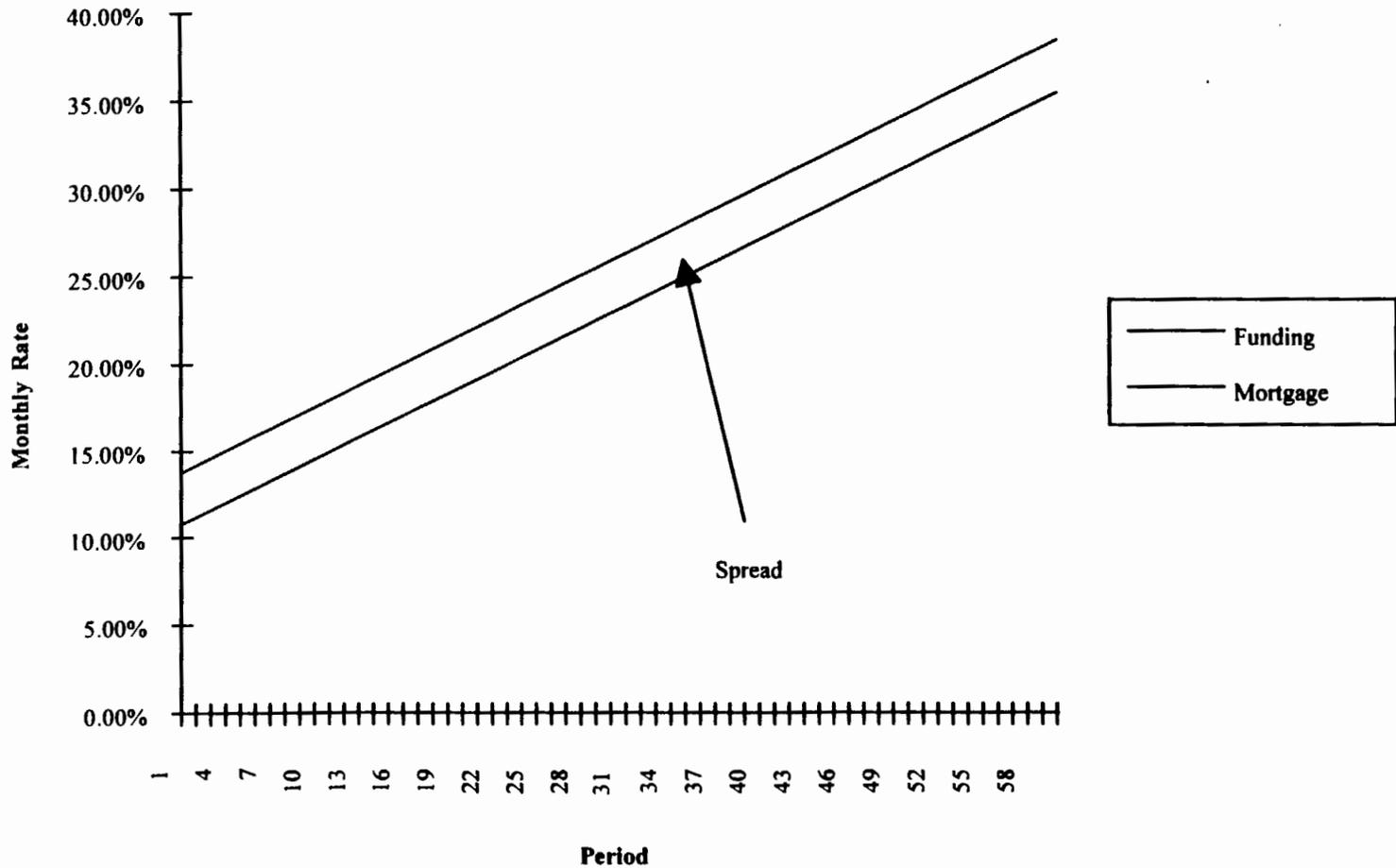
# Credit Risk Pricing in Various Countries

| <u>Country</u> | <u>Allocation Method</u> | <u>Pricing (%)</u> |
|----------------|--------------------------|--------------------|
| Denmark        | Top-up loan              | 0.34               |
| France         | Primary loan             | 0.78               |
| Germany        | Top-up loan              | 0.31               |
| United Kingdom | Mortgage insurance       | 0.63               |
| United States  | Mortgage insurance       | 0.35               |

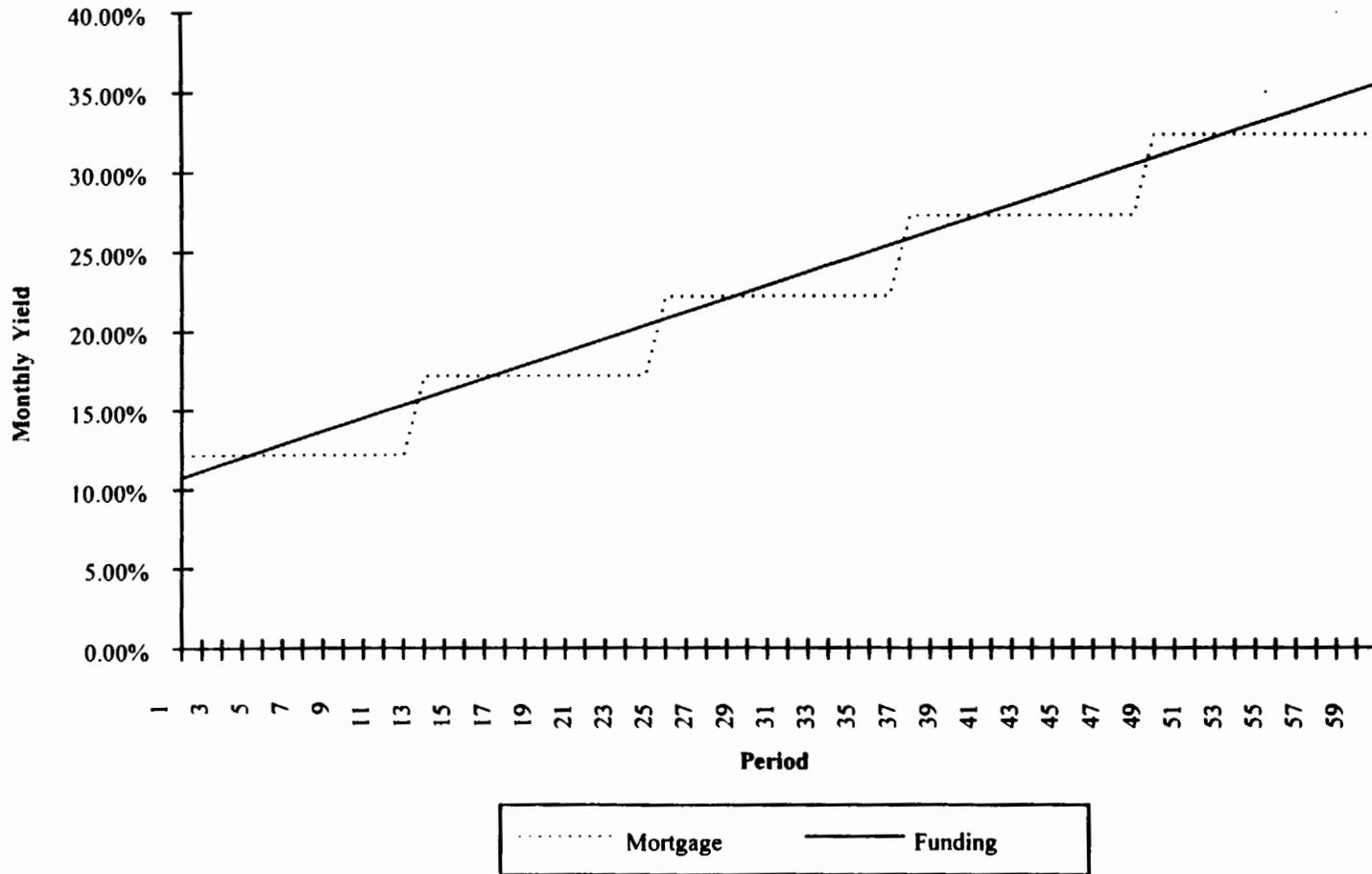
# Interest Rate Risk

The impact that changes in interest rates have on the value of a lending institution's assets, liabilities and income stream.

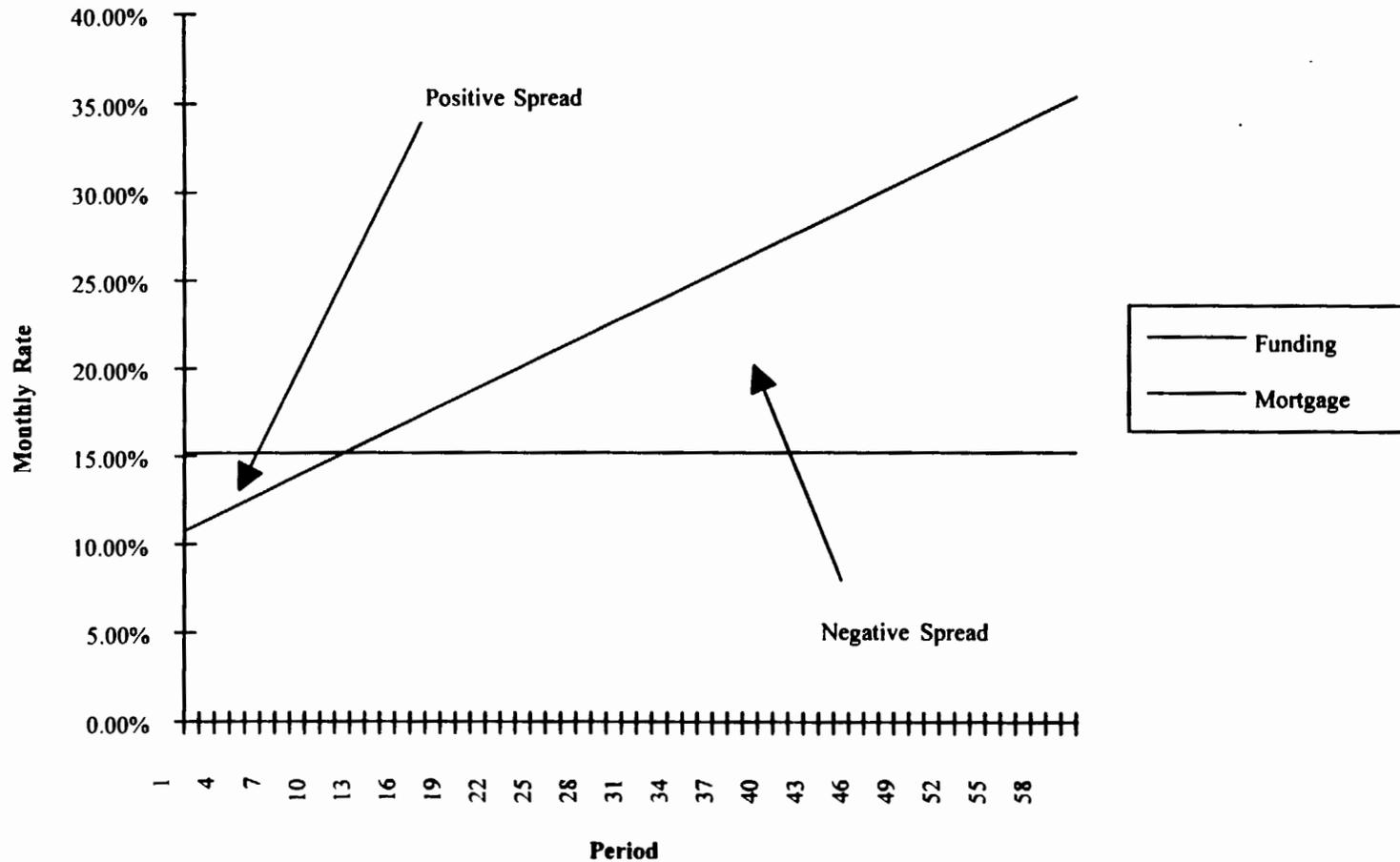
# Perfectly Matched Assets and Liabilities



# Interest Rate Mismatch



# Fixed Interest Rate Lending

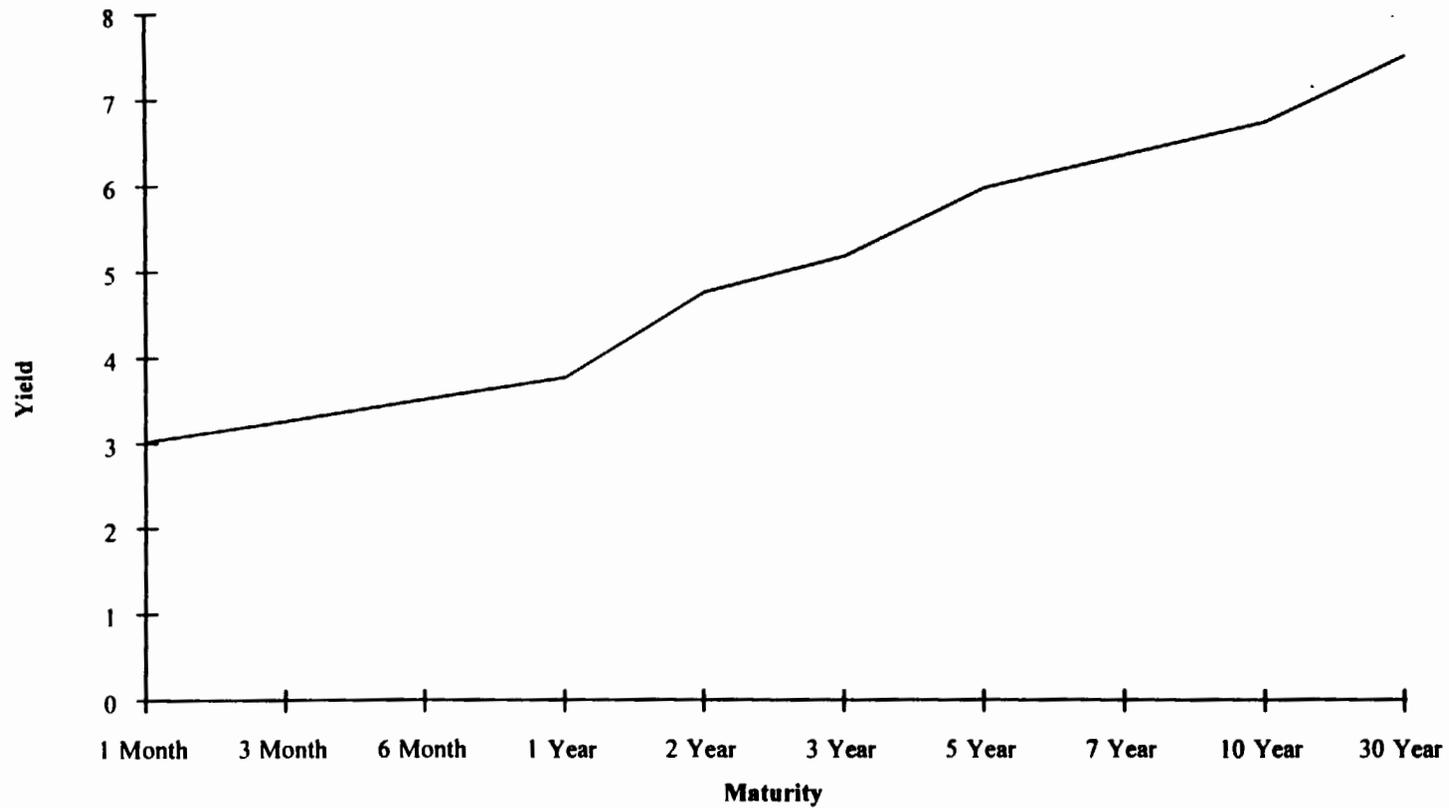


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# Management of Interest Rate Risk

- Periodic GAP
- Mark-to-market
- Income analysis simulation

# U.S. Treasury Yield Curve 12/92



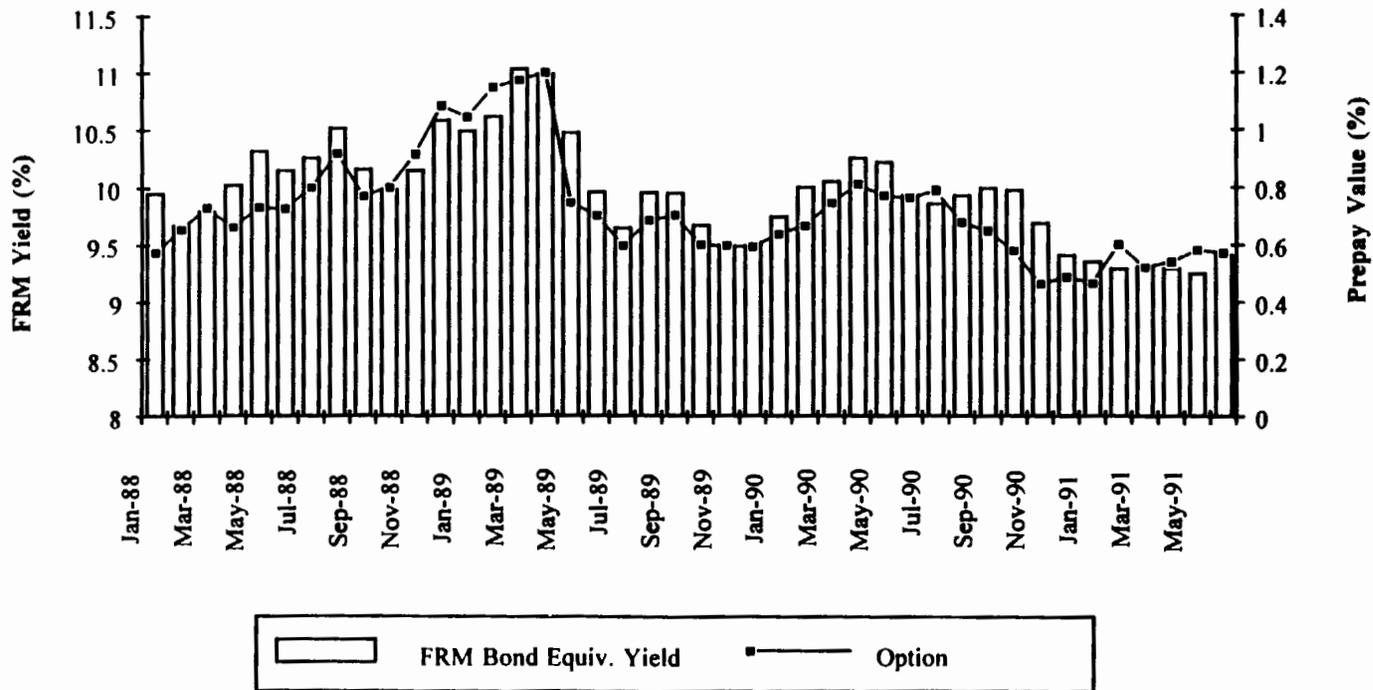
# Options Risk

Reinvestment loss due to early redemption of fixed rate mortgages (prepay loss) and funding loss associated with locking a rate to a borrower prior to loan closing (commitment risk). Loss due to borrower default (default risk).

# Loan Prepayment

- Risks
- Management

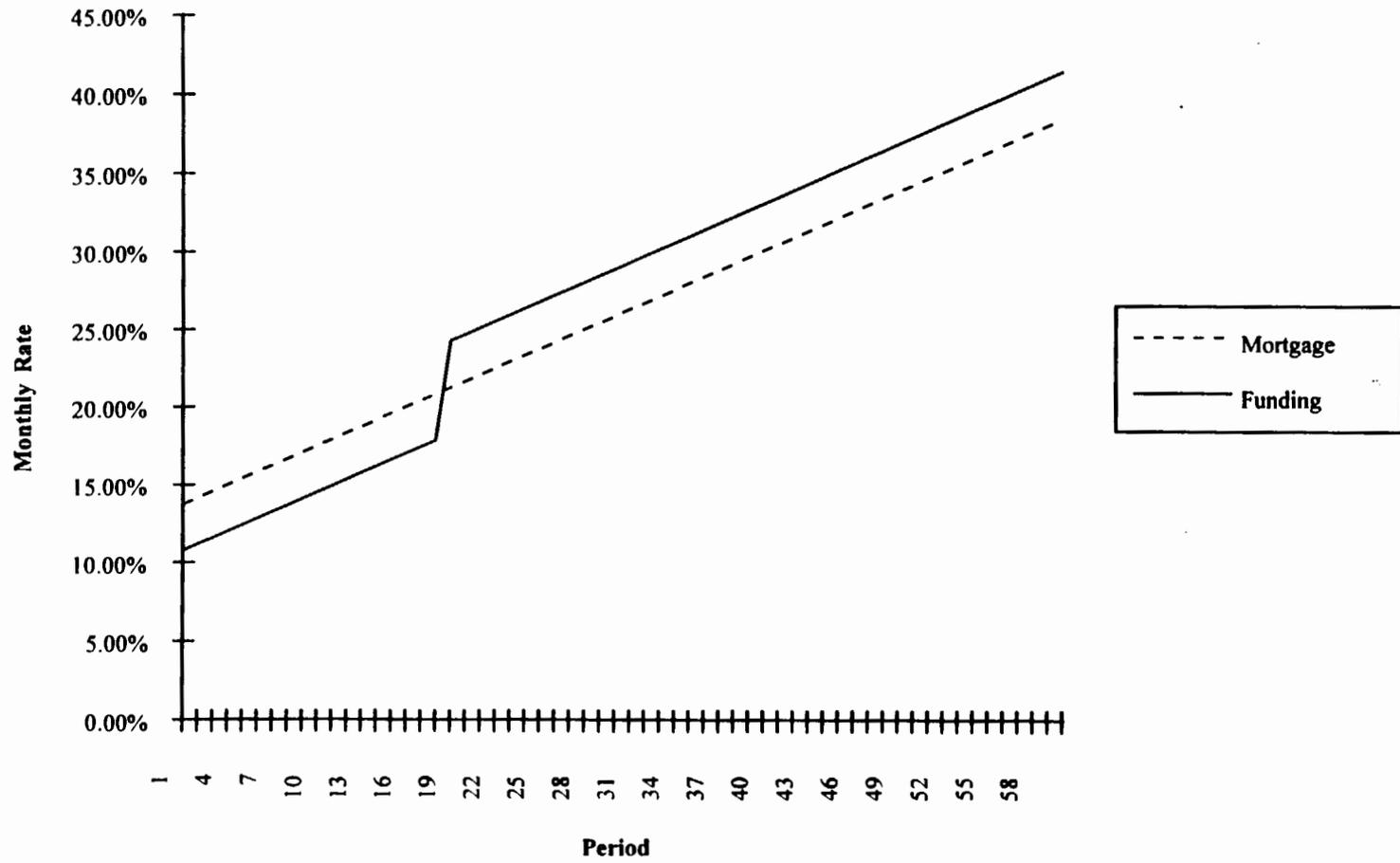
# U.S. Fixed Rate Mortgage Yields & Prepayment Option Values



# Spread Risk

Potential loss deriving from change in funding margin (relative to a reference rate) if lending with a fixed margin (relative to a reference rate).

# Spread Risk



# Liquidity Risk

- The ability of an institution to convert assets to cash.
- Expressed as the difference between the bid and ask price.

# Central Bank Reserve Accounts

## Countries that Require Reserve Accounts:

France

Germany (6-12% of timed accounts)

Italy (only country that pays interest on reserves)

Japan

Netherlands

Switzerland

UK

USA (3% of transaction accounts and timed deposits)

## Countries with No Reserve Requirements:

Belgium

Canada

# Methods for Managing Cash Needs

- Asset Sales
- Maintenance of liquidity portfolios
- Deposits
- Collateralized and uncollateralized borrowing
- Standby lines of credit
- Borrowing from the Central Bank



# Liquidity Risk Spread

$$\{(LR - RR) / (1 - CBR)\} - LR$$

Where:

LR = Loan Rate

RR = Rate paid by Central Bank on reserves

CBR = Reserve Requirement

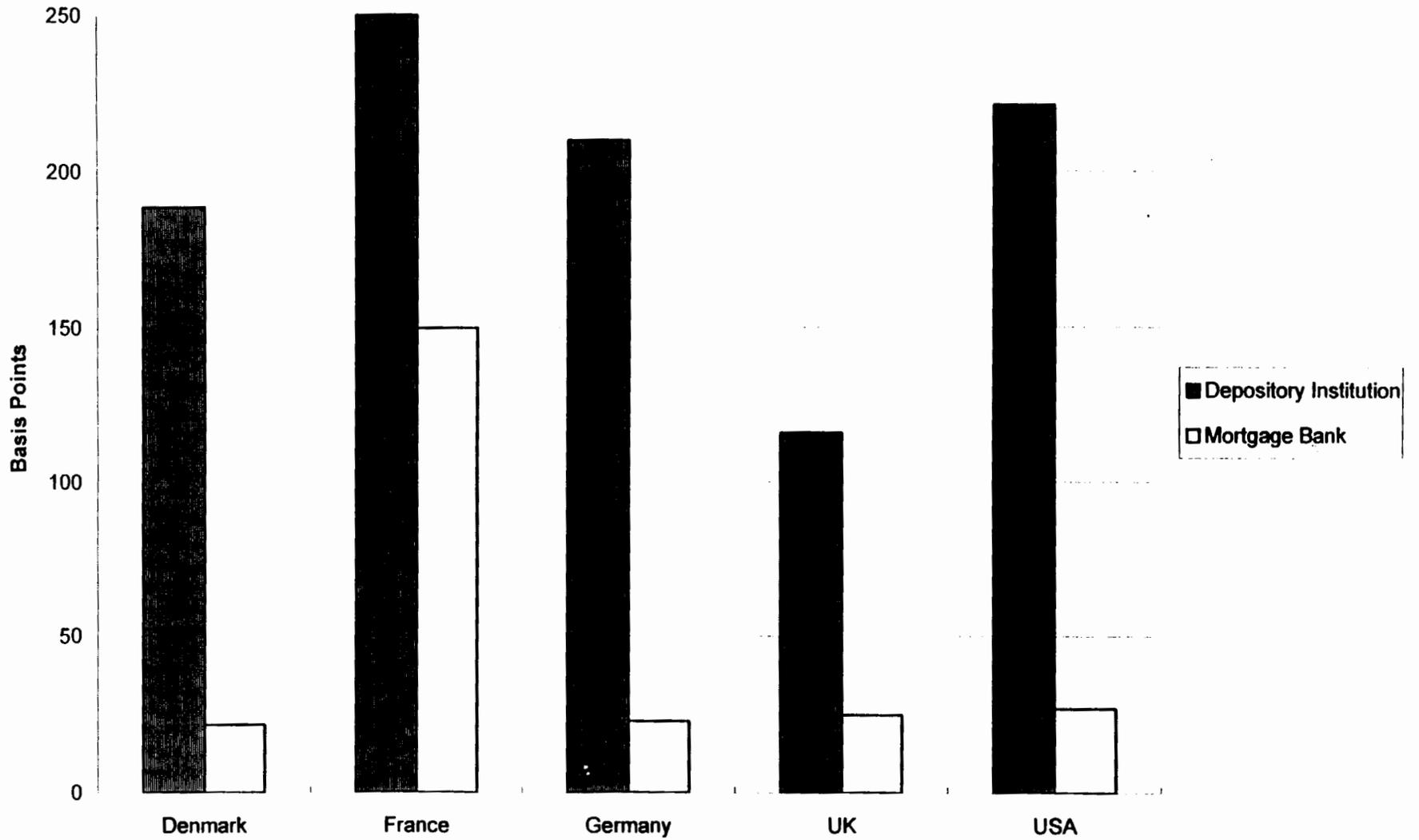
# Operating Costs

- Marginal cost of originating loan
- Marginal cost of funding loan
- Marginal cost of servicing loan

# Typical Funding Sources For Mortgages

- Deposits- commercial banks, savings and loans.
- Capital Markets- mortgage banks, wholesale lenders

**Average 1990 Operating Costs of Mortgage Lenders (% of Assets)**



# Profit Spread

The targeted return on shareholder investment net of expected losses and costs, necessary to compensate investors for the uncertainty of cost and loss estimates and the opportunity cost of their investment.

# Profit Spread

$$(\text{Equity}/\text{Assets})(R_s - R_d)$$

Where:

$R_s$  = Return to shareholders

$R_d$  = Return to depositors (e.g., interbank rate)

# Mortgage Lending Rate

$$DY(D/A) + EY(E/A) + \text{Spread}$$

Where:

DY = Debt Rate

EY = Equity Rate

E/A = Equity to Assets Ratio

Spread = Expected cost and risk adjustments

# Mortgage Spread

$$\text{Spread} = \text{CR} + \text{IRR} + \text{BR} + \text{OR} + \text{LR} + \text{AC}$$

Where:

CR = Credit Risk Premium

IRR = Interest Rate Risk Premium

BR = Spread Risk Premium

OR = Options Risk Premium

LR = Liquidity Risk Premium

AC = Marginal Operating Cost