Chapter 4

Managing Interest Rate Risk:
Gap and Earnings Sensitivity

Asset and liability management

- The phrase, asset – *liability management* has generally; however, come to refer to managing interest rate risk

  - Interest rate risk

    … unexpected changes in interest rates which can significantly alter a bank's profitability and market value of equity.

Asset and liability management committee

- A bank's asset and liability management committee (ALCO) coordinates all policy decisions and strategies that determine a bank's risk profit and profit objectives.

- Interest rate risk management is the primary responsibility of this committee.

Net interest income or the market value of stockholders' equity?

☐ Banks typically focus on either:
- ■ net interest income or
- ■ the market value of stockholders' equity

as a target measure of performance.

☐ GAP models are commonly associated with net interest income (margin) targeting.

☐ Earnings sensitivity analysis or net interest income simulation, or "what if" forecasting

Interest rate risk

☐ Reinvestment rate risk

… the risk that a bank can not reinvest cash flows from assets or refinance rolled over or new liabilities at a certain rate in the future

■ *Cost of funds versus the return on assets*

☐ ⇒ Funding GAP, impact on NII

☐ Price Risk

… changes in interest rates will also cause a change in the value (price) of assets and liabilities

■ Longer maturity (duration)

☐ ⇒ larger change in value for a given change in interest rates

☐ ⇒ Duration GAP, impact on market value of equity

Interest rate risk

Example: $10,000 Car loan
                   4 year Car loan at   8.5%
                   1 year CD at   4.5%
                          Spread   4.0%

But for How long?

Funding GAP

   GAP = $RSA - $RSL,

      where $RSA = $ amount of assets which will mature
   or reprice in a give period of time.

In this example:

      $GAP_{1y} = \$0.00 - \$10,000 = -\$10,000$

                   This is a negative GAP.

Funding GAP

□ Method

■ Group assets and liabilities into time "buckets" according to when they mature or are expected to re-price

■ Calculate GAP for each time bucket

■ Funding GAP_t
= \$ Value RSA_t - \$ Value or RSL_t

□ where t = time bucket; e.g., 0-3 months

Traditional static GAP analysis

1. Management develops an interest rate forecast
2. Management selects a series of "time buckets" (intervals) for determining when assets and liabilities are rate-sensitive
3. Group assets and liabilities into time "buckets" according to when they mature or re-price
   - The effects of any off-balance sheet positions (swaps, futures, etc.) are added to the balance sheet position
   - Calculate GAP for each time bucket
   - Funding GAP_t = $ Value RSA_t - $ Value or RSL_t
     - where t = time bucket; e.g., 0-3 months
4. Management forecasts NII given the interest rate environment

Rate sensitive assets and liabilities

- ☐ They include:
  - ■ maturing instruments,
  - ■ floating and variable rate instruments, and
  - ■ any full or partial principal payments.
- ☐ A bank's GAP is defined as the difference between a bank's rate sensitive assets and rate sensitive liabilities.
- ☐ It is a balance sheet figure measured in dollars for U.S. banks over a specific period of time.

What determines rate sensitivity?

☐ In general, an asset or liability is normally classified as rate-sensitive with a time frame if:

1. It matures
2. It represents and interim, or partial, principal payment
3. The interest rate applied to outstanding principal changes contractually during the interval
4. The outstanding principal can be repriced when some base rate of index changes and management expects the base rate / index to change during the interval

Factors affecting NII.

- ☐ Changes in the level of i-rates.
    - ☐ $\Delta NII = (GAP) * (\Delta iexp.)$
    - ■ Note: this assumes a parallel shift in the yield curve which rarely occurs
- ☐ Changes in the slope of the yield curve or the relationship between asset yields and liability cost of funds
- ☐ Changes in the volume of assets and liabilities
- ☐ Change in the composition of assets and liabilities

Expected balance sheet for hypothetical bank

Expected Balance Sheet for Hypothetical Bank

	Assets	Yield	Liabilities	Cost
Rate sensitive	500	8.0%	600	4.0%
Fixed rate	350	11.0%	220	6.0%
Non earning	150		100	
			920	
			Equity	
			80	
Total	1000		1000	

Factors affecting net interest income

- [ ] 1% increase in the level of all short-term rates
- [ ] 1% decrease in spread between assets yields and interest cost
  - RSA increase to 8.5%
  - RSL increase to 5.5%
- [ ] Proportionate doubling in size.
- [ ] Increase in RSA's and decrease in RSL's
  - RSA = 540, fixed rate = 310
  - RSL = 560, fixed rate = 260.

1% increase in short-term rates

Fixed rate	350	11.0%	220	6.0%
Non earning	150		100	
			920	
			Equity	
			80	
Total	1000		1000	

對外經濟貿易大學

Changes in NII

- $\Delta NII_{exp} = (GAP) * (\Delta i_{exp})$
- The larger is the GAP, the greater is the dollar change in NII.
- *This applies only in the case of a parallel shift in the yield curve, which is rare.
    - If rates do not change by the same amount, then the GAP may change by more or less.

1% decrease in spread

Expected Balance Sheet for Hypothetical Bank

	Assets	Yield	Liabilities	Cost
Rate sensitive	500	8.5%	600	5.5%
Fixed rate	350	11.0%	220	6.0%
Non earning	150		100	
			920	
			Equity	
			80	
Total	1000		1000	

Proportionate doubling in size

Rate sensitive	1000	8.0%	1200	4.0%
Fixed rate	700	11.0%	440	6.0%
Non earning	300		200	
			1840	
			Equity	
			160	
Total	2000		2000	

Increase in RSAs and decrease in RSLs

Rate sensitive	**540**	**8.0%**	**560**	**4.0%**
Fixed rate	**310**	**11.0%**	**260**	**6.0%**
Non earning	**150**		**100**	
			920	
			Equity	
			80	
Total	**1000**		**1000**	

Rate volume, and mix analysis

- ☐ Many banks publish a summary of how net interest income has changed over time.
- ☐ They separate changes over time to shifts in assets and liability composition and volume from changes associated with movements in interest rates.
- ☐ The purpose is to assess what factors influence shifts in net interest income over time.

对外经济贸易大学

Rate sensitivity reports

- A rate sensitivity report shows GAP values on a periodic and cumulative basis for each time interval.
  - Periodic GAP
    … measures the timing of potential income effects from interest rate changes
    - Gap for each time bucket
  - Cumulative GAP
    … measures aggregate interest rate risk over the entire period
    - Sum of periodic GAP's

Positive and negative gap's

☐ Positive GAP

...indicates a bank has more rate sensitive assets than liabilities, and that net interest income will generally rise (fall) when interest rates rise (fall).

☐ Negative GAP

...indicates a bank has more rate sensitive liabilities than rate sensitive assets, and that net interest income will generally fall (rise) when interest rates rise (fall).

对外经济贸易大学

Optimal value for a bank's GAP?

- ☐ There is no general optimal value for a bank's GAP in all environments.
- ☐ GAP is a measure of interest rate risk.
- ☐ The best GAP for a bank can be determined only by evaluating a bank's overall risk and return profile and objectives.
- ☐ Generally, the farther a bank's GAP is from zero, the greater is the bank's risk.

对外经济贸易大学

Speculating on the GAP. $\Delta NII = (GAP) * (\Delta i_{exp})$

- ☐ Many bank managers attempt to adjust the interest rate risk exposure of a bank in anticipation of changes in interest rates.
  - ■ This activity is speculative because it assumes that management can forecast rates better than forward rates embedded in the yield curve.
- ☐ Speculating on the GAP
  - ■ Difficult to vary the GAP and win – requires accurate interest rate forecast on a consistent basis.
  - ■ Usually only look short term.

Advantages / disadvantages of GAP

- ☐ The primary advantage of GAP analysis is its simplicity.

- ☐ The primary weakness is that it ignores the time value of money.

- ☐ GAP further ignores the impact of embedded options.

- ☐ For this reason, most banks conduct earnings sensitivity analysis, or pro forma analysis, to project earnings and the variation in earnings under different interest rate environments.

Link between GAP and net interest margin

☐ Some ALM programs focus on the GAP or GAP ratio when evaluating interest rate risk:

GAP Ratio = RSAs / RSLs

■ When the GAP is positive, the GAP ratio is greater than one.

■ A negative GAP, in turn, is consistent with a GAP ratio less than one.

GAP and potential variability in earnings

☐ Neither the GAP nor GAP ratio provide direct information on the potential variability in earnings when rates change.
  ■ The GAP ratio ignores size.
☐ <u>Example:</u> Consider two banks that have $500 million in total assets.
  ■ The first bank has $3 million in RSAs and $2 million in RSLs, its GAP = $1 million and its GAP ratio = 1.5 million.
  ■ The second bank has $300 million in RSAs and $200 million in RSLs.

Target NIM and GAP

- **A better risk measure relates the absolute value of a bank's GAP to earning assets.**
  - **The greater is this ratio, the greater the interest rate risk**
  - **The ratio of GAP to earning assets has the additional advantage in that it can be directly linked to variations in NIM.**

$$\frac{\text{Target GAP}}{\text{Earning assets}} = \frac{(\text{Allowable \% change in NIM})(\text{Expected NIM})}{\text{Expected \% change in interest rates}}$$

Example

- **Management expects interest rates to vary up to 4 percent during the upcoming year**

- **The bank's ratio of its 1-year cumulative GAP (absolute value) to earning assets should not exceed 25 percent.**

  Target GAP/Earning assets (.20)(0.05) / 0.04 = 0.25

Earnings sensitivity analysis

- ☐ Shifts in the yield curve are rarely parallel!

- ☐ It is well recognized that banks are quick to increase base loan rates but are slow to lower base loan rates when rates fall.

对外经济贸易大学

Exercise of embedded options in assets and liabilities

- Customers have different types of options, both explicit and implicit:
  - Option to refinance a loan
  - Call option on a federal agency bond the bank owns
  - Depositors option to withdraw funds prior to maturity

Interest rate risk and embedded options

Example: $10,000 Car loan
                4 year Car loan at   8.5%
                1 year CD at   4.5%
                        Spread   4.0%

But for How long?

Funding GAP

GAP = $RSA - $RSL,

where $RSA = $ amount of assets which will mature or reprice in a give period of time.

In this example:

$GAP_{1y} = \$0.00 - \$10,000 = -\$10,000$

This is a negative GAP.

Implied options:

☐ In the previous example, what if rates increased?

■ **<u>1 year GAP position:</u>**

-3	-2	-1	base	+1	+2	+3
-1,000	-2,000	-8,000	-10,000 Gap	-10,000	-10,00 0	-10,000
Re-finance the auto loans				All CD's will mature		

Implied options:

□ In the previous example, what if rates increased?

■ **3 month GAP is zero by definition:**

-3	-2	-1	base	+1	+2	+3
+8,000	+6,000	+2,000	0 Gap	-1,000	-3,000	-6,000
Re-finance the auto loans, and less likely to "pull" CD's				People will "pull" the CD's for higher returns		

The implications of embedded options

- Is the bank the buyer or seller of the option
  - Does the bank or the customer determine when the option is exercised?
- How and by what amount is the bank being compensated for selling the option, or how much must it pay to buy the option?
- When will the option be exercised?
  - Often determined by the economic and interest rate environment
- Static GAP analysis ignores these embedded options

# Earnings sensitivity analysis consists of six general steps:

1. Forecast future interest rates,
2. Identify changes in the composition of assets and liabilities in different rate environments,
3. Forecast when embedded options will be exercised,
4. Identify when specific assets and liabilities will reprice given the rate environment,
5. Estimate net interest income and net income, and
6. Repeat the process to compare forecasts of net interest income and net income across rate environments.
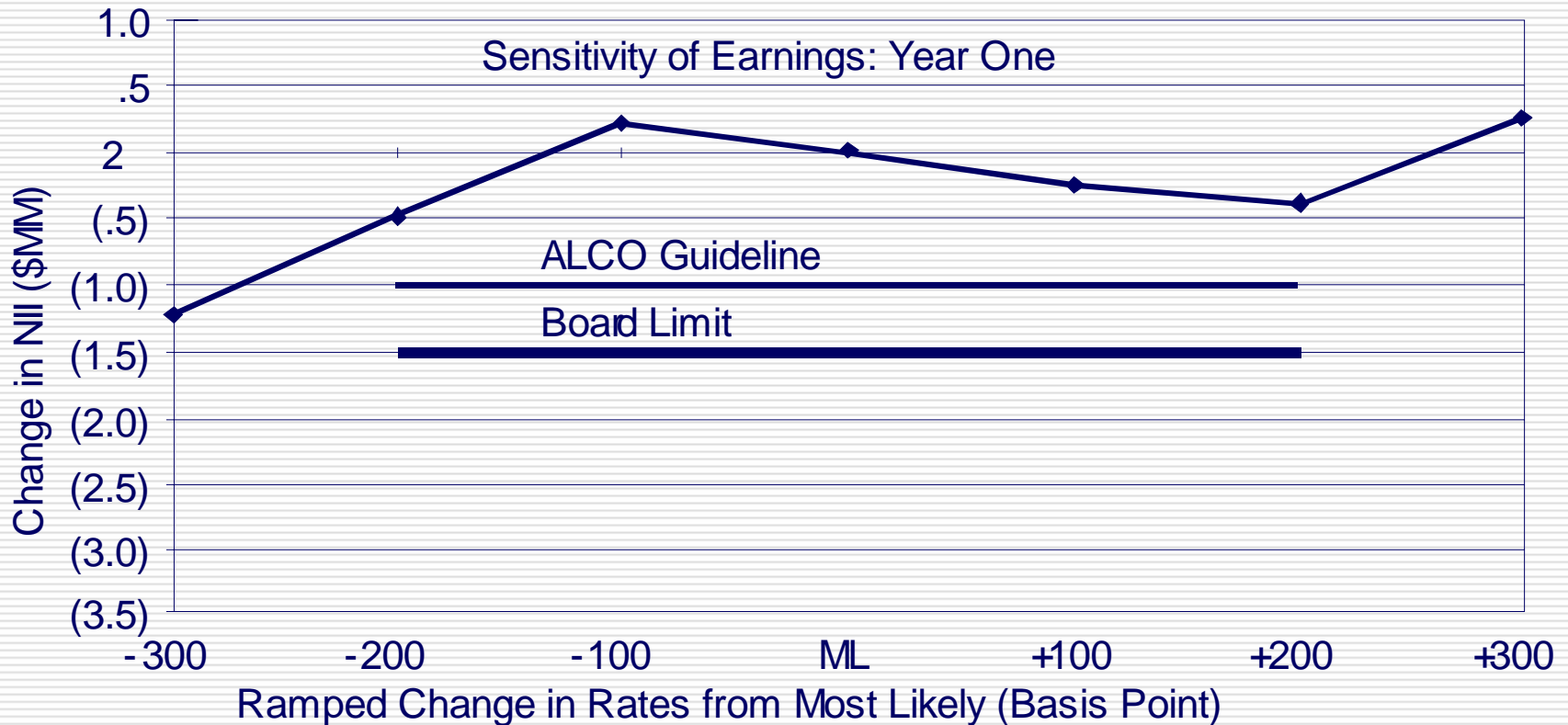
Interest Rate Forecasts
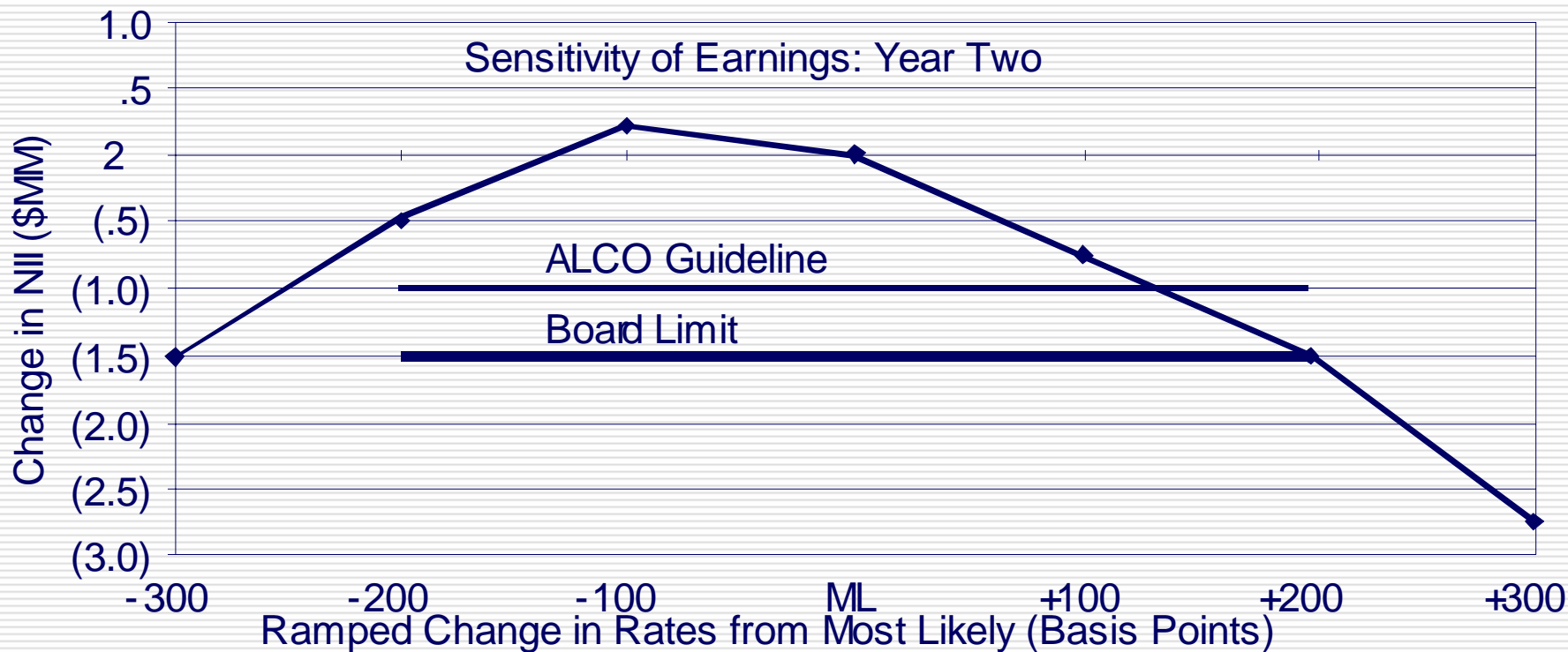
Most Likely Forecast and Rate Ramps Dec. 2001
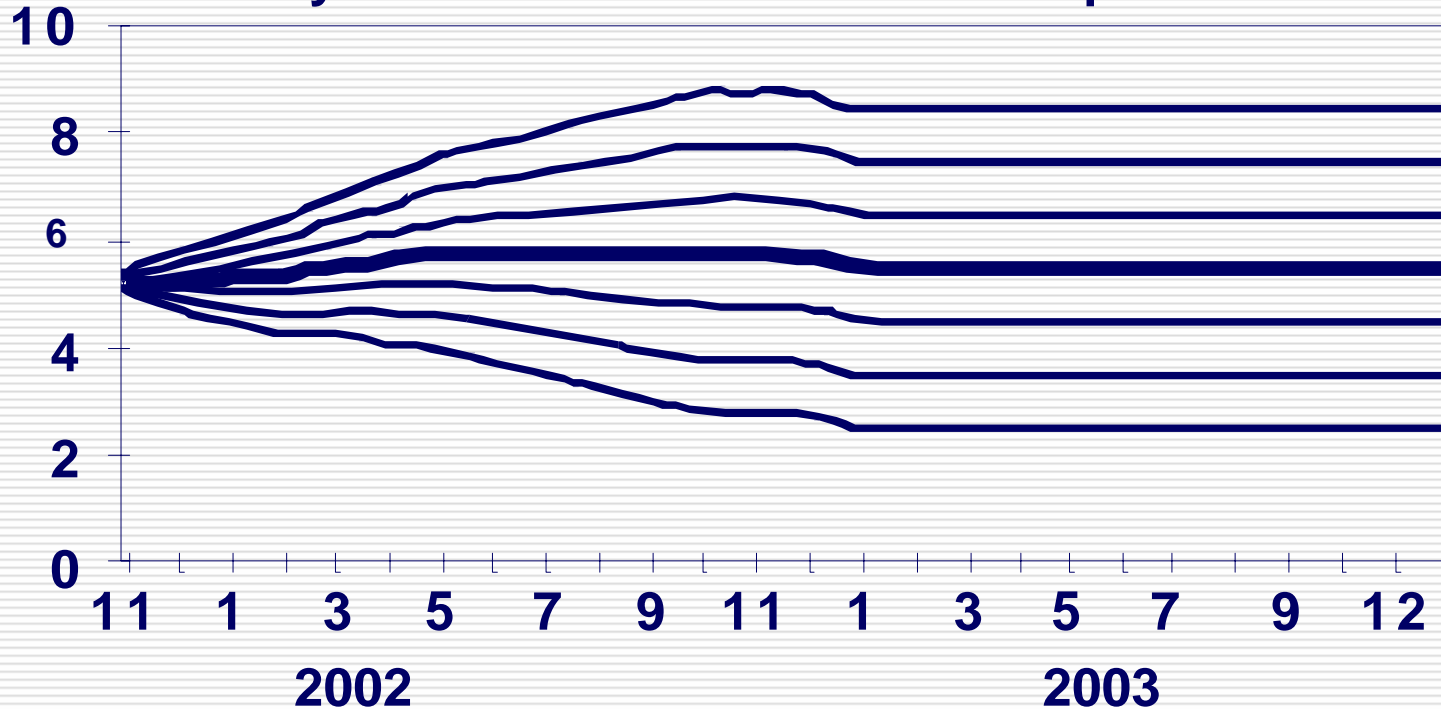
Interest Rate Forecasts

Fed Funds Forecast vs. Implied Forward Rates

Market Implied Rates

Most Likely Forecast
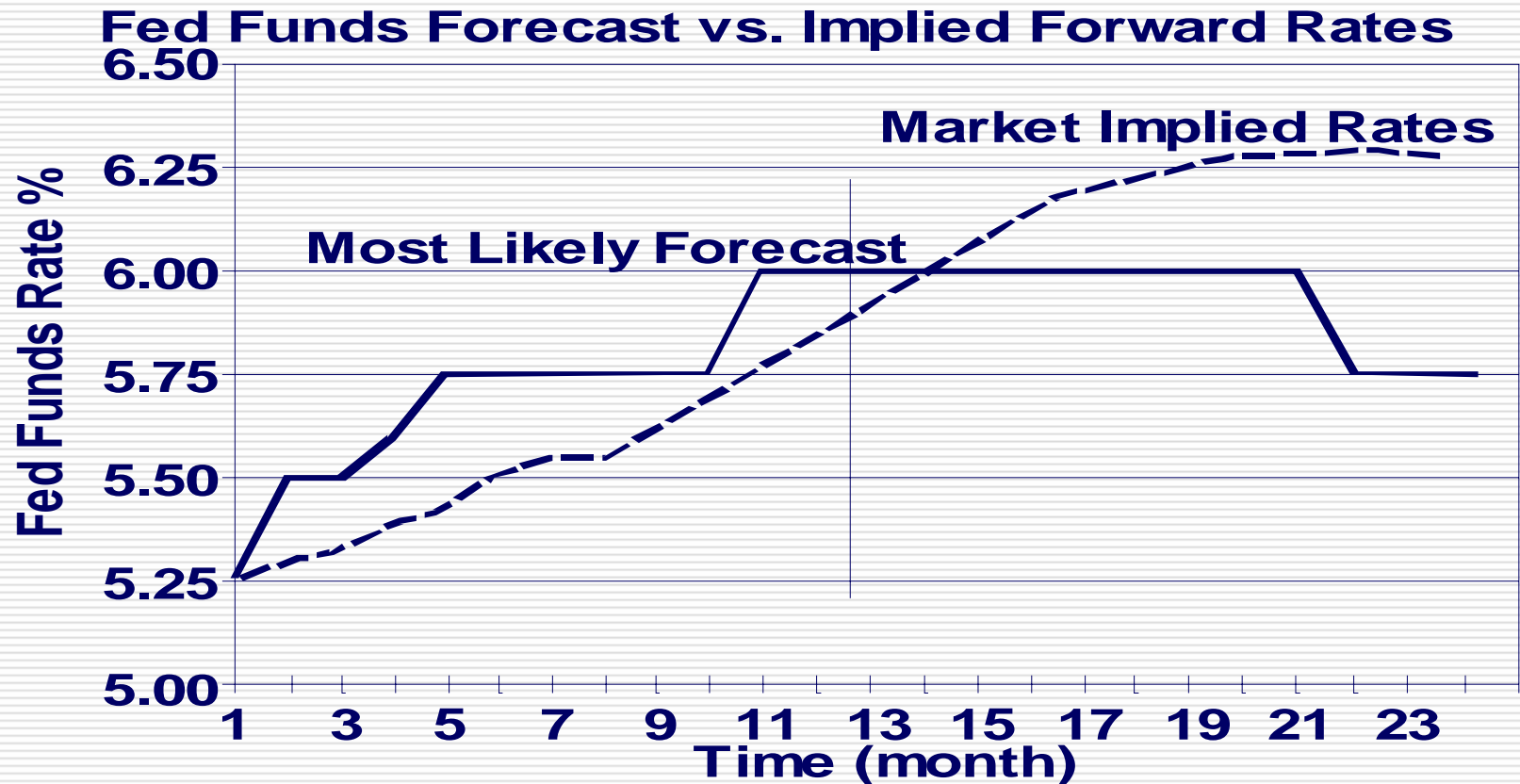
Earnings sensitivity over one and two years versus most likely rate scenario

Earnings sensitivity over one and two years versus most likely rate scenario

Earnings at risk

- ☐ Demonstrates the potential volatility in earnings across these environments.

- ☐ The greater is the potential variation in earnings (earnings at risk), the greater is the amount of risk assumed by a bank.

Earnings-at-risk for PNC and Washington Mutual

	Gradual Change in Interest Rates*			
PNC	**-2%**	**-1%**	**1%**	**2%**
Net interest income change for next 1 year (2002)		-2.80%	-0.30%	
Washington Mutual				
Net interest income change for next 1 year (2002)		1.47%		-5.18%
Net income change for next 1 year (2002)		2.19%		-2.76%

Income statement gap

- For smaller banks with limited off-balance sheet exposure, one procedure is to use Income Statement GAP analysis.

- This model uses an all encompassing Earnings Change Ratio (ECR).

  - This ratio attempts to incorporate information on each asset and liability.

Steps that banks can take to reduce interest rate risk

- [ ] Calculate periodic GAPs over short time intervals.

- [ ] Match fund repriceable assets with similar repriceable liabilities so that periodic GAPs approach zero.

- [ ] Match fund long-term assets with noninterest-bearing liabilities.

- [ ] Use off-balance sheet transactions, such as interest rate swaps and financial futures, to hedge.

Adjust the effective rate sensitivity

Objective	Approaches
Reduce asset sensitivity	Buy longer-term securities. Lengthen the maturities of loans. Move from floating-rate loans to term loans.
Increase asset sensitivity	Buy short-term securities. Shorten loan maturities. Make more loans on a floating-rate basis.
Reduce liability sensitivity	Pay premiums to attract longer-term deposit instruments. Issue long-term subordinated debt.
Increase liability sensitivity	Pay premiums to attract short-term deposit instruments. Borrow more via non-core purchased liabilities.

对外经济贸易大学