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MANAGEMENT OF COMMERCIAL BANKING

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Module 03: Asset-Liability Management (ALM): Management of Interest Rate Risk

Lecture 21: Overview of Asset Liability Management

CONCEPTS COVERED

- Asset Liability Management
- Interest Rate Risk
- Gap analysis

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Overview of Asset-Liability Management

- Decisions on buying and selling the securities, how to fund their investments and lending activities etc.
- These decisions are based on: (i) direction of interest rate, (ii) compositions of assets and liabilities, (iii) degree of risk
- The process of making such decisions about the composition of assets and liabilities and risk assessment is known as *asset-liability management* (ALM)
- These decisions are made by the asset-liability management committee (ALCO)
- The basic objective is to manage the interest rate risk

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Interest Rate Risk

- The potential loss from unexpected changes in interest rates which can significantly alter a bank's profitability and market value of equity.
- When a bank's assets and liabilities do not reprice at the same time, the result is a change in net interest income.
- The change in the value of assets and the change in the value of liabilities will also differ, causing a change in the value of stockholder's equity
- Spread Risk (reinvestment rate risk): Changes in interest rates will change the bank's cost of funds as well as the return on their invested assets. They may change by different amounts.
- Price Risk: Changes in interest rates may change the market values of the bank's assets and liabilities by different amounts.

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Example

Assets (Rs. Million)	Liabilities (Rs. Million)
5 year fixed rate loan= 100	30 day deposits= 90
Interest rate= 8%	Interest rate= 4%
	Equity= 10
Total: 100	Total= 100

Net interest income (NII): Interest income – interest expenses

= Rs. 8-Rs. 3.6 = Rs. 4.4

Net interest margin (NIM) = NII / Earnings assets = 4.4/100 = 4.4%

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Example cont…

- Let market interest rate increases, the cost of short-term borrowing will increase but the interest earned from the long-term fixed loans will remain unchanged.
- If interest rate increases by 2%, the interest expenses will be: Rs. 5.4
- NII = Rs.8-Rs.5.4= Rs. 2.6, NIM= 2.6%
- If the bank had made the loans at a floating rate, the NIM would have increased to (Rs. 10-Rs. 5.4) = Rs. 4.6 or 4.6%
- NII depends upon (i) interest earned on assets and paid for funds, (ii) Amount of funds raised and invested

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Techniques of Interest Risk Management

- GAP Analysis
  - A static measure of risk that is commonly associated with net interest income (margin) targeting
- Earnings Sensitivity Analysis
  - Earnings sensitivity analysis extends GAP analysis by focusing on changes in bank earnings due to changes in interest rates and balance sheet composition

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Gap Analysis

- All assets and liabilities are classified into two groups i.e. interest rate sensitive and non-interest rate sensitive
- Gap analysis classifies assets or liabilities according to their interest sensitivity
- Those assets and liabilities whose interest income or cost vary with interest rate changes over some given time horizon are known as rate-sensitive assets (RSAs) and rate sensitive liabilities (RSLs)
- Those assets and liabilities whose interest income or cost do not vary with interest rate movements over same time horizon are referred as non-rate sensitive (NRS)

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Gap Analysis Cont…

- Rate sensitivity depends on the frequency of repricing
- Short-term assets and liabilities are more rate sensitive than assets and liabilities having longer term maturities
- Assets and liabilities with longer term maturities but with variable rate of interest are also interest rate sensitive.
- Selection of time period over which the measures are made is crucial i.e. an asset or liability, which is rate sensitive in 60 days may not be rate sensitive in 30 days.

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Gap Analysis Cont…

- Selection of time period over which the measures are made is crucial i.e. an asset or liability, which is rate sensitive in 60 days may not be rate sensitive in 30 days.
- The time periods are called as maturity buckets or planning horizons
- Over a long time period almost all assets and liabilities are interest-rate sensitive
- As the time period becomes shorter, the ratio of rate sensitive to non rate sensitive assets and liabilities falls.
- Each bank decides on those time periods that match its needs.

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Classification of Assets and Liabilities by interest Rate Sensitivity

Assets			Liabilities		
Cash	NRS	30	Demand deposits	NRS	15
Short-term securities	RSA	30	Short-term savings	RSL	50
Variable-rate loans	RSA	50	Borrowings from Central bank	RSL	65
Short-term loans	RSA	25	Money market deposits	RSL	30
Long-term securities	NRS	60	Equity	NRS	20
Long-term loans	NRS	50	Long-term savings	NRS	75
Other assets	NRS	10			
Total		255	Total		255

Note:
NRS= Non-rate sensitive asset or liability
RSA= Rate-sensitive asset
RSL =Rate-sensitive liability

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CONCLUSION

- The process of making commercial banking decisions about the composition of assets and liabilities and risk assessment is known as *asset-liability management* (ALM)
- Interest rate risk is the potential loss from unexpected changes in interest rates which can significantly alter a bank's profitability and market value of equity.
- A static measure of risk that is commonly associated with net interest income (margin) targeting
- Gap analysis classifies assets or liabilities according to their interest sensitivity

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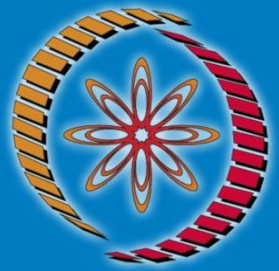
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Module 03: Asset-Liability Management (ALM): Management of Interest Rate Risk

Lecture 22: Dollar Gap Analysis

CONCEPTS COVERED

- Dollar Gap
- Asset and Liability Sensitivity
- Gap, Interest Rates and Profitability

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Dollar Gap Analysis

Dollar gap (funding gap or maturity gap) is the difference between the dollar amount of interest rate sensitive assets (RSA) and dollar amount of interest rate sensitive liabilities (RSL)

Dollar Gap= RSA (Dollar) – RSL (Liabilities)

For comparative purpose we use Relative Gap Ratio and Interest-Sensitivity Ratio

Relative gap ratio = Gaps / Total assets

Interest- sensitivity ratio = RSA / RSL

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Dollar Gap Analysis Cont…

- Asset sensitive banks have positive gap, positive relative gap ratio and interest-sensitivity ratio greater than 1
- Liability sensitive banks have negative gap, negative relative gap ratio and interest-sensitivity ratio lesser than 1
- Banks that are asset sensitive always experience an increase in their net interest income when interest rate increases and decrease in their net interest income when interest rate falls
- Banks that are liability sensitive always experience an increase in their net interest income when interest rate falls and decrease in their net interest income when interest rate increases

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Gap and NII

ΔNII = RSA (dollar)* Δi - RSL (dollar)* Δi = Gap (dollar) * ΔI

Where, ΔNII = Expected change in the dollar amount of NII

ΔI = Expected change in the interest rate

Example: RSA = Rs. 65 million, RSL = Rs. 45 million, Gap = Rs. 20 million

If interest rate rises from 7% to 9%, the net interest income would rise by Rs. 20 million * (0.02) = Rs. 400,000 expected change in NII

If the Gap is negative, the change in NII will decline

The effect of interest rate change on NIM depends on the previous level of NII as well as size of the assets

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Gap, Interest Rate Changes and Net Interest Income

Gap		Change in Interest Rate	Change in NII
Positive	RSA>RSL	Increase	Increase
Positive	RSA>RSL	Decrease	Decrease
Negative	RSA<RSL	Increase	Decrease
Negative	RSA<RSL	Decrease	Increase
Zero	RSA=RSL	Increase	No change
Zero	RSA=RSL	Decrease	No change

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Incremental and Cumulative Gaps

- Incremental gap measures the difference between rate sensitive assets and relative sensitive liabilities over increments of the planning horizon
- Cumulative gap measures the difference between rate sensitive assets and liabilities over a more extended period
- Cumulative gap is the sum of the incremental gaps
- If there is only one planning horizon, the incremental gap and cumulative gap are the same

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Incremental and Cumulative Gaps : Example

Days	Assets maturing or re-priced within (Rs. Million)	Liabilities maturing or re-priced within (Rs. Million)	Incremental Gap (Rs. Million)	Cumulative Gap (Rs. Million)
0-30	60	40	+20	20
31-90	35	30	+5	25
91-180	0	20	-20	5
181-365	0	5	-5	0
	95	95		

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Managing Interest Rate Risk With Dollar Gaps

- There are two types ALM strategy to manage interest rate risk: (1) Defensive ALM (2) Aggressive ALM

Defensive asset-liability management:

✓Objective is to insulate the net interest increase from changes in interest rate, i.e. to prevent interest rate changes from decreasing or increasing net interest income

✓It attempts to keep the dollar gap near zero

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Managing Interest Rate Risk With Dollar Gaps Cont…

Aggressive Asset Liability Management:

- ✓It focuses on increasing the net interest income through altering the portfolio of the bank
- ✓Success of aggressive ALM depends on the ability to forecast future interest rate changes
- ✓It includes two steps:
  i. Prediction of direction of interest rate
  ii. Adjustment of the sensitive assets and liabilities to take advantage of the projected interest rate changes

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Managing Interest Rate Risk With Dollar Gaps: Aggressive ALM Cont..

Rising Interest Rate Scenario	Falling Interest Rate Scenario
✓Banks try to keep the positive dollar gap i.e. RSA>RSL ✓They can follow the strategies like: i. Shortening the maturity of its assets by selling long-term securities and using the funds to purchase short-term securities ii. Making more variable rate loans	✓Maintain a negative gap ✓Maturity of fixed rate assets should be lengthened ✓Amount of variable rate assets should be reduced ✓Shortening the maturity of liabilities i.e. replacing CDs with government fund borrowings

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Balance Sheet Adjustment

- Use of financial instruments on its balance sheet in adjusting its assets and liabilities
- Use of money market instruments to adjust the assets and liabilities on the asset side
- In the liability side, the commercial banks may use certificate of deposits in various sizes and maturities to adjust the assets and liabilities to manage the interest rate risk

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Limitation of Dollar Gap

- Selection of the time horizon
- Multiple gap can be calculated in different maturity buckets
- Correlation between market interest rate and interest income is not perfect and instantaneous
- Focus is only on net interest income rather than shareholder wealth
- Aggressive gap management may increase the level of income but it is also likely to add to the volatility of the income
- Defensive gap management may also decline the shareholders wealth due to the change in the market value of assets and liabilities

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CONCLUSION

- Dollar gap (funding gap or maturity gap) is the difference between the dollar amount of interest rate sensitive assets (RSA) and dollar amount of interest rate sensitive liabilities (RSL)
- Banks that are asset sensitive always experience an increase in their net interest income when interest rate increases and decrease in their net interest income when interest rate falls
- Banks that are liability sensitive always experience an increase in their net interest income when interest rate falls and decrease in their net interest income when interest rate increases
- There are two types ALM strategy to manage interest rate risk: (1) Defensive ALM (2) Aggressive ALM

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Module 03: Asset-Liability Management (ALM): Management of Interest Rate Risk

Lecture 23: Earnings Sensitivity Analysis

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CONCEPTS COVERED

- Earnings sensitivity
- Exercise of embedded options in assets and liabilities
- Management of earnings sensitivity risk

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Earnings Sensitivity Analysis

- It carries out ‘what if’ analysis of all factors that affect the NII across a wide range of potential interest rate environments
- It repeats static GAP analysis assuming different interest rate environments and compares expected net interest income between the different environments

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Steps in Earning Sensitivity Analysis

1. Forecast interest rates
2. Forecast balance sheet size and composition given the assumed interest rate environment
3. Forecast when embedded options in assets and liabilities will be in the money
4. Identify which assets and liabilities will re-price over different time horizons and by how much under the assumed interest rate environment

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Steps in Earning Sensitivity Analysis Cont…

5. Identify off-balance sheet items that have cash flow implications under the assumed interest rate environment

6. Calculate net interest income and net income under the assumed interest rate environment

7. Select a new interest rate environment and compare the forecasts of net interest income and net income across different interest rate environments versus the base case

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Scenario Building

- Typical comparison looks at seven different interest rate scenarios, beginning with a base rate or most likely scenario
- This may be based on current rates, forward rates implied by the yield curve or management's specific forecast of interest rate
- Each of the other scenario then assumes that rates move systematically higher by +1, +2, and +3 percent or lower by -1, -2, and -3 percent

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Exercise of Embedded Options in Assets And Liabilities

- Assets and liabilities may have embedded options like prepayment of loan, call option feature in the bond, early withdrawals of deposits etc
- Issues to be addressed in this case are:
  i. Whether the bank is the buyer or seller of the option?
  ii. If the bank is the seller, then how and by what amount the bank is compensated for selling the option or how much must it pay if it buys option
  iii. Bank should forecast when the option will be exercised
- It allows management to identify a worst case scenario and have better sense of maximum loss potential

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Off-Balance Sheet Contracts

- Recognize the bank's off-balance sheet contracts like future, swaps, options etc
- Each type of contract may have different cash flow effects in different interest rate scenario which ultimately affects bank net interest income and expense
- The effect of these contracts should be included in any forecast of net interest income and net income volatility

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Variations in Interest Rate Changes in Different Times

- Earning sensitivity analysis allows management to incorporate the impact of different competitive markets for various balance sheet accounts with alternative pricing strategies
- Forecasting different spreads between asset yields and liability interest costs when rates change by different amounts
- Example: Banks are quick to increase the base loan rates when interest rates increase but are slow to lower base loan rate when interest rate declining

Variations in Interest Rate Changes in Different Times Cont..

- Difference between loan rate and deposit rate at the time of interest rate changes
- The implication is that the impact on the banks net interest income is different due to different timing of rate changes and different magnitude of rate changes
- The impact of interest rate change is not straight forward

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Managing Earning Sensitivity Risk

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

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CONCLUSION

- Earnings sensitivity analysis carries out ‘what if’ analysis of all factors that affect the NII across a wide range of potential interest rate environments
- Assets and liabilities may have embedded options like prepayment of loan, call option feature in the bond, early withdrawals of deposits
- Earning sensitivity analysis allows management to incorporate the impact of different competitive markets for various balance sheet accounts with alternative pricing strategies

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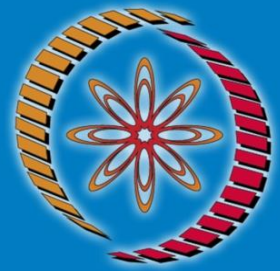
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Module 03: Asset-Liability Management (ALM): Management of Interest Rate Risk

Lecture 24: Duration Gap Analysis

CONCEPTS COVERED

- Duration Gap
- Interest Rate, DGAP and Value of Equity

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Duration Gap Analysis

- Duration is defined as the weighted average time to receive all cash flows from a financial instrument
- Duration of a portfolio is defined as the weighted average of each of the asset's duration with the weights being the proportion of investment funds allotted to each asset (w_i)

$$D_p = \sum w_i D_i$$

- Duration gap is the difference between the duration of a bank's assets and liabilities

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Duration Gap Analysis Cont….

- It is a measure of interest rate sensitivity that helps to explain how changes in interest rate affect the market value of a bank's assets and liabilities, and also the net worth (NW)

$$NW = A - L$$

NW = Net Worth
A = Assets
L = liabilities

$$\Delta NW = \Delta A - \Delta L$$

Δ = change in value

- Duration Gap (DGAP) = $D_A - wD_L$

  D_A = Average duration of assets
  D_L = Average duration of liabilities
  W= Ratio of (TL/TA)

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Example: Duration of Asset and Liability

Asset	Value (Rs. Million)	Duration (Years)	Liabilities	Value (Rs. Million)	Duration (Years)
Cash	100	0.00	Certificate of deposits	400	1.00
Business loan	400	2.00	Fixed deposits	400	6.00
Other loan	500	6.00			
Total Assets	1000		Total liabilities	800	
			Equity	200	
			Total	1000	
Duration of assets = 0.1*0.00+0.4*2+0.5*6 =3.8 years			Duration of liabilities = 0.5*1+0.5*6 =3.5 years		

DGAP = 3.8 -0.8*3.5 =1yr

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Application of Duration Gap

- How will the value of assets and liabilities and value of network change as interest rate change?
- The effect of changing interest rates on the net worth is related to the duration gap

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Interest Rate, DGAP and Value of Equity

- We know $\Delta NW = \Delta A - \Delta L$
- $\Delta NW = [-D_A *(\Delta_i/(1+i))*A]-[- D_L *(\Delta_i/(1+i))*L]$

  As $\Delta A/A$ is approximately equal to the product of asset duration times the change in interest rates $[-D_A *(\Delta_i/(1+i))]$ & $\Delta L/L$ is approximately equal to the liabilities duration times the change in interest rates $[- D_L *(\Delta_i/(1+i))]$
- In other words: Change in value of net worth = [- average duration of assets * [change in interest rate/(1+ original discount rate)] *total assets] – [- average duration of liabilities * [change in interest rate/(1+ original discount rate)] *total liabilities]

Interest Rate, DGAP and Value of Equity Cont…

In other way it can be calculated as follows:

$$\Delta NW/TA \approx -DGAP \cdot \Delta_i / (1+i)$$

$$\Delta NW \approx [-DGAP \cdot \Delta_i / (1+i)]*TA$$

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Example Cont..

Continuation with the previous example: Assume there is a 1% change in interest rate and original discount rate is 11%

ΔNW= (-3.8*(0.01/1.11)*1000)-(-3.5*(0.01/1.11)*800)
= (-3.8*0.009*1000)-(-3.5*0.009*800)
= (-3.8*9)-(-3.5*7.2)
=-34.2-(-25.2)
=-34.2 +25.2 =9
Using the other formula we get:
-1*0.009*1000=9

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Observations

- If interest rate will increase, the value of net worth will decline
- For rising interest rates, the value of assets would drop more than the value of liabilities and thus value of net worth drops
- For falling interest rates, the value of the assets would rise more than the value of liabilities and the value of net worth would increase

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Defensive and Aggressive Duration Gap Management

Duration Gap	Change in Interest Rate	Change in Net Worth
Positive	Increase	Decrease
Positive	Decrease	Increase
Negative	Increase	Increase
Negative	Decrease	Decrease
Zero	Increase	No change
Zero	Decrease	No change

Anticipation of interest rate movement is a part of aggressive strategy

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CONCLUSION

- Duration gap is a measure of interest rate sensitivity that helps to explain how changes in interest rate affect the market value of a bank's assets and liabilities, and also the net worth (NW)
- For rising interest rates, the value of assets would drop more than the value of liabilities and thus value of net worth drops
- For falling interest rates, the value of the assets would rise more than the value of liabilities and the value of net worth would increase

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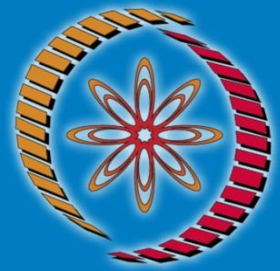
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Module 03: Asset-Liability Management (ALM): Management of Interest Rate Risk

Lecture 25: Duration Gap Analysis-II

CONCEPTS COVERED

- Immunization
- Economic Value of Equity Sensitivity Analysis

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Immunization

- Duration Gap (DGAP) should be zero
- Bank should operate with average asset duration slightly below its average liability duration
- The value of equity remains constant as both the value of asset and liability change due to change in interest rate
- The target variable is the economic value of equity

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Example

Assets	Market Value (Rs. Million)	Rate (%)	Duration	Liabilities and Equity	Market Value(Rs. Million)	Rate (%)	Duration
Cash	100			1 year deposit	620	5	1.00
3 Year loan	700	12	2.69	3 year CDs	300	7	2.81
6 year bond	200	8	4.99	Total Liabilities	920		
				Equity	80		
Total	1000		2.88		1000		1.59
DGAP= 2.88 – (920/1000)(1.59) = 1.42							

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Example Cont…

Assets	Market Value (Rs. Million)	Rate (%)	Duration	Liabilities and Equity	Market Value(Rs. Million)	Rate (%)	Duration
Cash	100			1 year deposit	340	5	1.00
3 Year loan	700	12	2.69	3 year CDs	300	7	2.81
6 year bond	200	8	4.99	Zero coupon CD	280	8	6.00
				Total Liabilities	920		
				Equity	80		
Total	1000		2.88		1000		3.11
DGAP = 2.88 -0.92(3.11) = 0							

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Immunization Cont…

- Banks may choose other target variable like book value of interest income
- Duration of bank's equity equal to length of time horizon that the bank wishes to use in hedging net interest income
- Duration of equity: (MV of assets * Duration of assets – MV of liabilities * duration of liabilities)/ Economic value of equity

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Immunization Cont…

For a 1 year time horizon the duration gap will be:

DGAP*= MVRSA (1-DRSA) – MVRSL (1- DRSL)

Where,

MVRSA = Cumulative market value of rate sensitive assets

MVRSL = Cumulative market value of rate sensitive liabilities

DRSA = Composite duration of RSAs for given time horizon ; equal to the sum of the products of each asset's duration with the relative share of its total market value of assets

DRSL = Composite duration of RSLs for given time horizon ; equal to the sum of the products of each liability's duration with the relative share of its total market value of liabilities

Gap Analysis Cont…

- If DGAP* >0, bank's NII will decrease when interest rates decrease and increase when interest rate increase
- If DGAP* <0; the relationship is reversed
- If DGAP* =0, then interest rate risk eliminated

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Sensitivity Analysis of Economic Value of Equity

- Extends the static DGAP analysis
- Conducting what if analysis of all the factors that affect EVE across a wide range of interest rate environments
- It is often known as net portfolio value (NPV) or market value of equity (MVE) analysis
- How volatile EVE might be compared with some base case or most likely scenario
- Consider seven rate environments beginning with the base case
- Consider the embedded options
- Greater the potential volatility, greater is risk

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Strengths of DGAP and EVE Sensitivity Analysis

- Recognize the time value of cash flows
- Avoid the problem of choosing the appropriate time buckets
- Duration measures are additive in nature, so individual matching is unwarranted
- Provide greater flexibility for adjustment of assets and liabilities
- Shareholder interest is taken care

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Weaknesses of DGAP and EVE Sensitivity Analysis

- Difficult to measure duration accurately
- Incorrect measure of discount rate
- Requirement of constant rebalancing
- Difficult to measure duration for assets that do not earn or pay interest

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CONCLUSION

- In the process of immunization the duration gap should be equal to zero
- Bank should operate with average asset duration slightly below its average liability duration
- When book value of interest income is the target, in the process of immunization, duration of bank's equity equal to length of time horizon that the bank wishes to use in hedging net interest income
- Sensitivity analysis of economic value of equity is conducting what if analysis of all the factors that affect EVE across a wide range of interest rate environments

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