

**MUNI
ECON**

Bank Asset/Liability Management

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Example

€ 100 million 5-year fixed-rate loans at 8% = € 8 million interest

€ 90 million 30-day time deposits at 4% = € 3.6 million interest

€10 million equity

Calculate Net interest income and Net interest margin (NIM).

Assume that interest rates rise 2% (deposit costs will rise in next year but not loan interest). How it affects NII and NIM?

Example - solution

€ 100 million 5-year fixed-rate loans at 8% = € 8 million interest

€ 90 million 30-day time deposits at 4% = € 3.6 million interest

€10 million equity

Net interest income = € 4.4 million

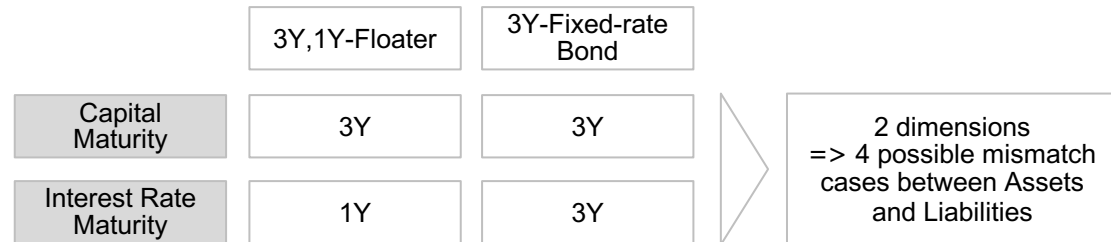
Net interest margin (NIM) = $(€ 8 - € 3.6) / € 100 = 4.4\%$

If interest rates rise 2%, deposit costs will rise in next year but not loan interest. Now, NIM = $(€ 8 - € 5.4) / € 100 = 2.6\%$.

Thus, NIM depends on interest rates, the amount of funds, and the earning mix (rate x amount).

Asset liability gaps

1. Maturities



2. Risk:= Maturity mismatches/ gaps

Liquidity-risk (gap):
Mismatch in capital-maturity

Interest rate-risk (gap):
Mismatch in interest rate maturity

		Liquidity Risk			
		Yes		No	
Interest Rate Risk	Yes	1 3Y-Loan, fixed-rate rate (3Y IR) 1Y-deposit, fixed-rate rate (1Y IR)		2 3Y-Loan, fixed-rate rate (3Y IR) 3Y-deposit, 1Y-floating (1Y IR)	
	No	3 3Y-Loan, 1Y-floating (1Y IR) 1Y-deposit, fixed-rate rate (1Y IR)		4 3Y-Loan, fixed-rate rate (3Y IR) 3Y-deposit, fixed-rate rate (3Y IR)	

Asset liability gaps

	Liquidity risk/ mismatch		Liquidity risk/ mismatch	
	No	Yes	No	Yes
Loan capital maturity	3Y		3Y	
Funding capital mat'y	3Y		1Y	
Loan, Ly premium	0.75%		0.75%	
Funding, Ly premium	0.75%		0.25%	
Liquidity return	0		0.50%	
	Interest rate risk/ mismatch		Interest rate risk/ mismatch	
	No	Yes	No	Yes
Loan IR maturity	3Y	3Y	1Y	3Y
Funding IR mat'y	3Y	1Y	1Y	1Y
Loan, risk-free IR	1.50%	1.50%	0.50%	1.50%
Funding, risk-free IR	1.50%	0.50%	0.50%	0.50%
IR return	0	1.00%	0	1.00%

Conclusion: Risk <=> Return	Liquidity risk/ mismatch			
	Interest rate risk/ mismatch		Interest rate risk/ mismatch	
	No	No	Yes	Yes
	No	Yes	No	Yes
Liquidity return	0	0	0.50%	0.50%
IR return	0	1.00%	0	1.00%

Managing Interest Rate Risk: GAP and Earnings Sensitivity

Banks use two basic models to assess interest rate risk.

- **Interest rate gap and earnings sensitivity analysis** emphasizes income statement effects by focusing on how changes in interest rates and the bank's balance sheet effect net interest income and net income.
- **Duration gap and economic value of equity analysis** emphasizes the market value of stockholders' equity by focusing on how these same changes affect the market value of assets vs. the market value of liabilities.

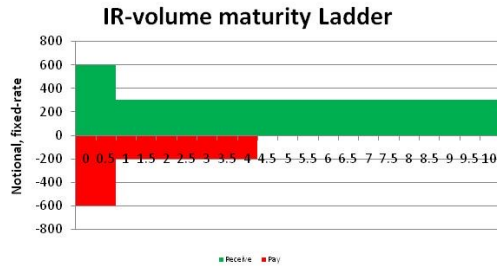
Risk Framework	Target Performance Measure	Risk Measure
GAP and earnings sensitivity	Net interest income/NIM Net income	GAP/earning assets GAP ratio (RSAs/RSLs) Variation in net interest income versus base case Maximum acceptable loss of net interest income versus base case
Duration gap and economic value of equity sensitivity	Economic Value of Equity (EVE)	Duration gap Variation in economic value of equity Maximum acceptable loss of economic value of equity versus base case

ALM

		Assets	Liabilities		
300	300	Loan, 6.00% 3Y, 0.5Y	Funding, 6.00% 0.5Y, 0.5Y	400	200
		Loan, 7.00% 10Y, 10Y	Funding, 6.50% 4Y, 4Y		

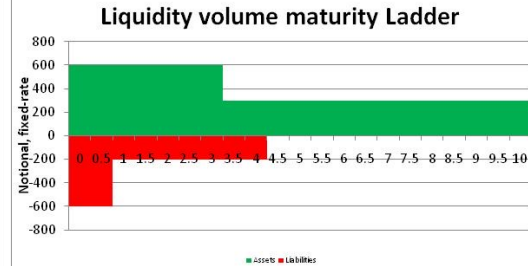
Interest rate risk

- Plot volumes with their interest rate maturity

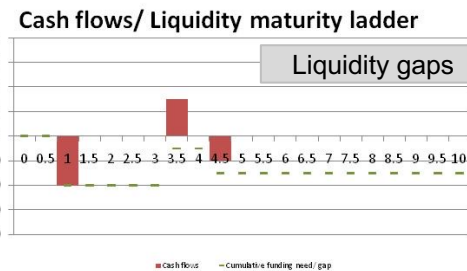
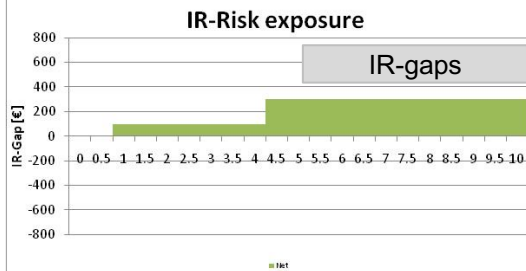


Liquidity risk

- Plot volumes with their liquidity maturity

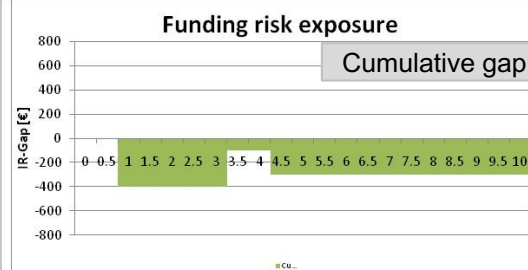
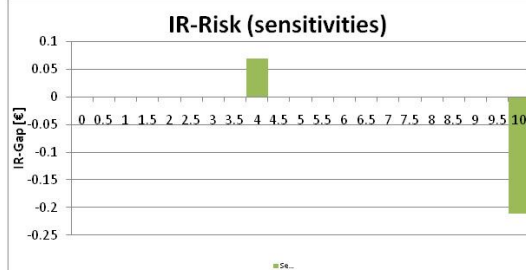


- Plot net position (= uncovered position)



- Plots cash flows (= Δ -view of volume ladder/ previous plot)

- Plots IR-sensitivity in each bucket



- Plots funding needs (=uncovered/ unfunded assets)

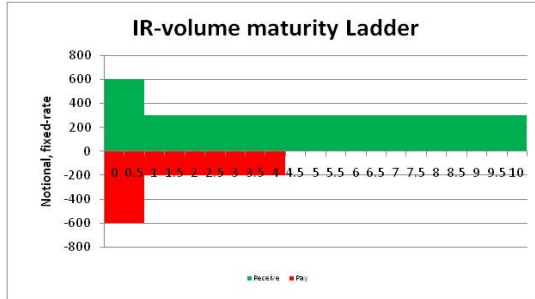
ALM

- Replacing the loan by a bond that can be sold within 6M => Ly maturity: 6M.
- IR-profile: unchanged, Ly risk: reduced.

		Assets	Liabilities		
300		Bond, 6.00% 3Y, 0.5Y	Funding, 6.00% 0.5Y, 0.5Y	400	
300		Loan, 7.00% 10Y, 10Y	Funding, 6.50% 4Y, 4Y	200	

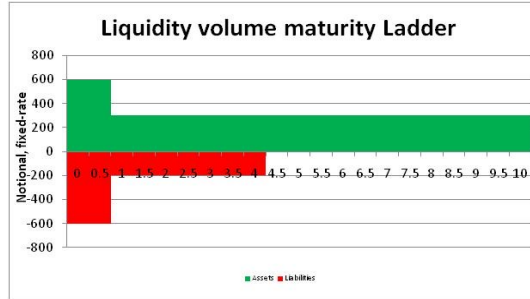
Interest rate risk

- Plot volumes with their interest rate maturity

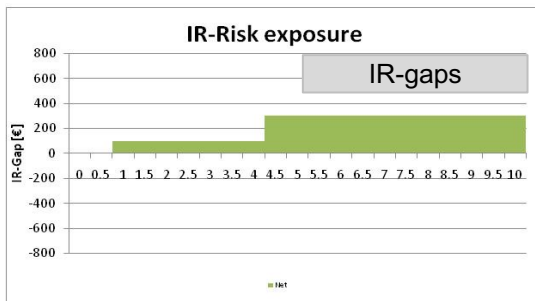


Liquidity risk

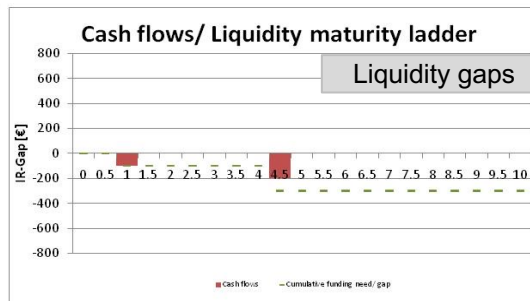
- Bond enters with its “liquidation horizon”, not with its legal maturity



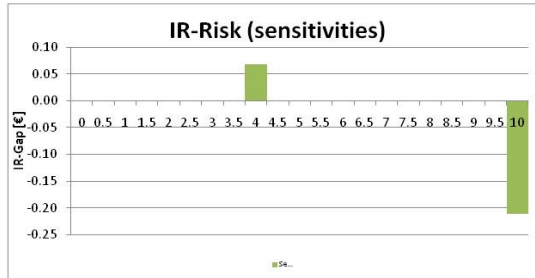
- Plot net position (= uncovered position)



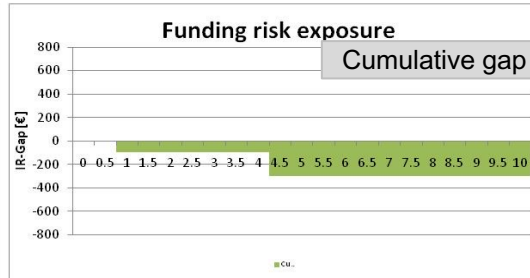
- Partially counter-balances/ nets outflow of 6M-funding (-400, 6M)



- Plots IR-sensitivity in each bucket



- Open/ uncovered funding position is reduced



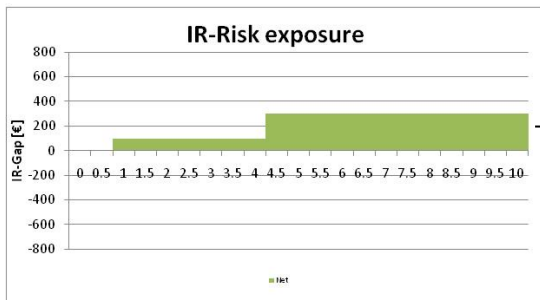
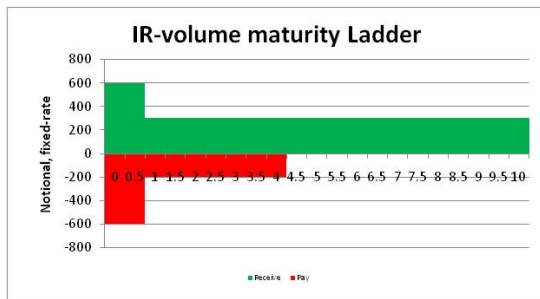
Interest rate gap

		Assets	Liabilities		
300		Loan, 6.00% 3Y, 0.5Y	Funding, 6.00% 0.5Y, 0.5Y	400	
300		Loan, 7.00% 10Y, 10Y	Funding, 6.50% 4Y, 4Y	200	

The IR-gap directly translates into a change in Net Interest Income:

$$\text{IR-Gap} = A_{ir} - L_{ir} \quad (\text{Volume of interest rate-sensitive assets and liabilities})$$

$$\Delta \text{NII} = \text{Gap}^{\text{cum}} * \Delta r = (A_{ir} - L_{ir}) * \Delta r \quad (\Delta r : \text{interest rate relevant for valuation})$$



- Positively gapped
- NII increases in rising interest rates because new funding at roll-over dates (100 at t=0.5, 300 at t=4) becomes more expensive.
- NII grows in decreasing rate environment

Traditional interest rate gap analysis

Steps in IR-gap Analysis:

1. Develop an interest rate forecast.
2. Select a series of sequential time intervals for determining what amounts of assets and liabilities are rate sensitive within each time interval.
3. Group assets and liabilities into these time intervals or “buckets” according to time to first repricing.
4. Calculate IR-gap.
5. Forecast net interest income given the assumed interest rate environment and repricing characteristics of the underlying instruments.

Interest rate gap analysis

			0.5	0.5	1	3	∞
		Total	[ON, 6M]	(6M, 12M]	(1Y, 2Y]	(2Y, 5]	(5Y, ∞]
Assets	Mortgages, fixed rate	125.00	10.00	10.00	25.00	40.00	40.00
	Mortgages, floating rate	100.00	50.00	50.00			
	Interbank demand deposits	75.00	75.00				
	Sovereign bonds	60.00			30.00	0.00	30.00
	Cash	20.00					20.00
	Non-earnings assets	20.00					20.00
	Total assets	400.00	135.00	60.00	55.00	40.00	110.00
Liabilities	Term deposits	-200.00	-50.00	-100.00	-50.00		
	Retail Demand deposits	-125.00	-125.00				
	Interbank demand deposits	-25.00	-25.00				
	Non-interest bearing liabilities	-10.00					-10.00
	Capital	-40.00					-40.00
	Total Liabilities	-400.00	-200.00	-100.00	-50.00	0.00	-50.00
Swap	Receive [fix]	200.00			100.00	100.00	
	Pay [floating]	-200.00	-200.00				
	Periodic gap		-265.00	-40.00	105.00	140.00	60.00
	Cumulative gap		-265.00	-305.00	-200.00	-60.00	0.00
	Δ r	1.00%					
	Δ NII per bucket		-1.33	-1.53	-2.00	-1.80	
	Δ NII per bucket p.a.		-2.65	-3.05	-2.00	-0.60	
	(1) Fixed rate volumes, Receive		465.00	405.00	250.00	110.00	0.00
	(2) Fixed rate volumes, Pay		-200.00	-100.00	-50.00	-50.00	0.00
	(1) + (2) = CumGap		265.00	305.00	200.00	60.00	0.00
	Δ NII per bucket		-1.33	-1.53	-2.00	-1.80	
	Δ NII per bucket p.a.		-2.65	-3.05	-2.00	-0.60	

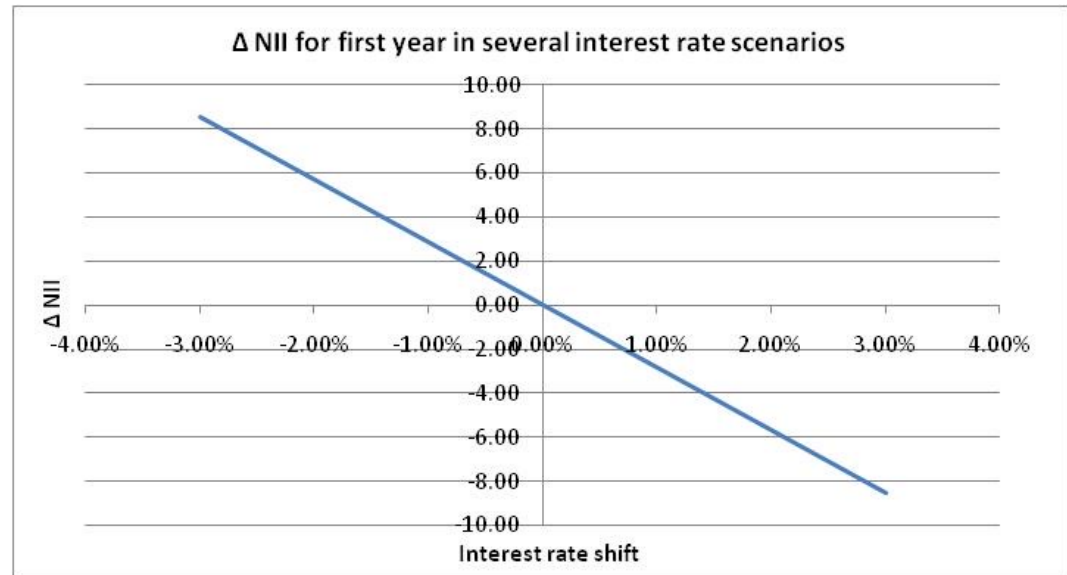
*(-1)

→ = (400-135)+(200-0) ← = 465-60-0 ← = 250-40-100

Interest rate gap analysis

			0.5	0.5	1	3	∞
		Total	[0N, 6M]	(6M, 12M]	(1Y, 2Y]	(2Y, 5]	(5Y, ∞]
	Δ NII per bucket	1%	-1.33	-1.53	-2.00	-1.80	

	Change in Income in [0,1Y]
-3.00%	8.55
-2.00%	5.70
-1.00%	2.85
0.00%	0.00
1.00%	-2.85
2.00%	-5.70
3.00%	-8.55

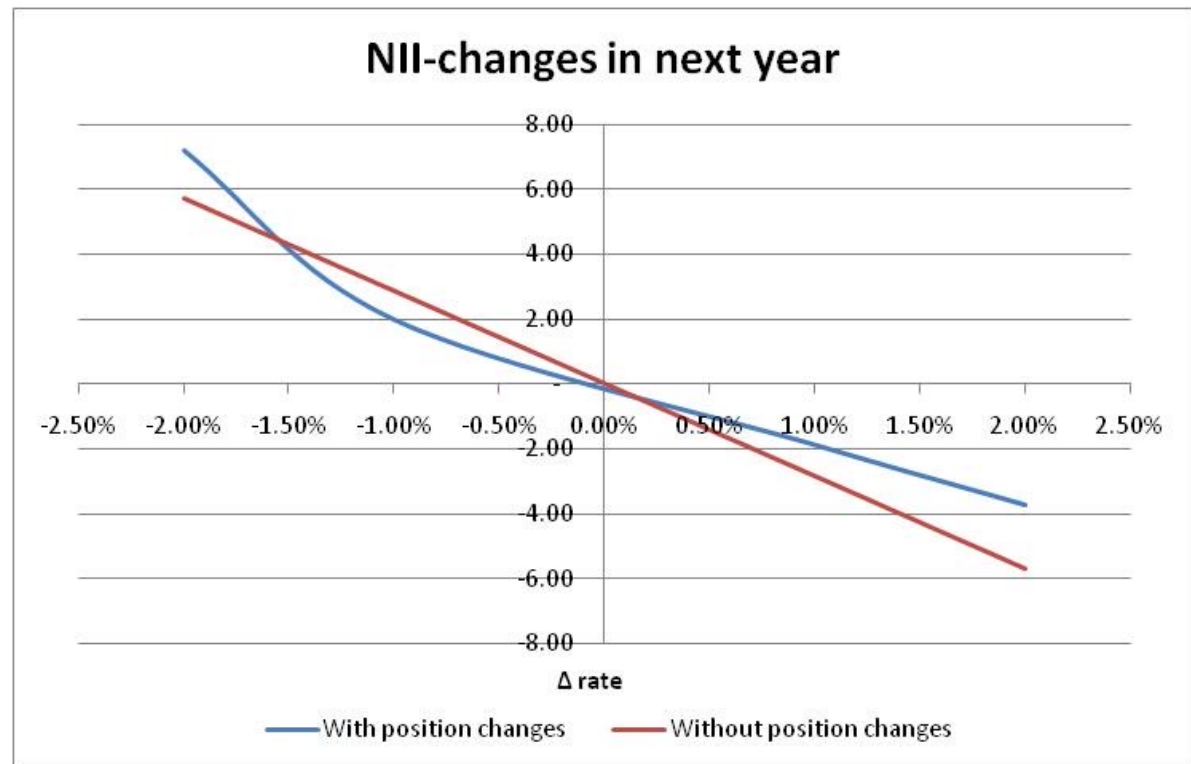


Interest rate gap analysis

	Elasticity parameter							
125	-10%	Mortgages, fixed rate						
75	-5%	Interbank demand deposits						
Assets	Δ r	Position	Total	[ON, 6M]	(6M, 12M]	(1Y, 2Y]	(2Y, 5]	(5Y, ∞]
	-2.00%	Mortgages, fixed rate	140.75	11.26	11.26	28.15	45.04	45.04
	-2.00%	Interbank demand deposits	82.50	82.50	0.00	0.00	0.00	0.00
	-1.00%	Mortgages, fixed rate	137.50	11.00	11.00	27.50	44.00	44.00
	-1.00%	Interbank demand deposits	80.95	80.95	0.00	0.00	0.00	0.00
	1.00%	Mortgages, fixed rate	112.50	9.00	9.00	22.50	36.00	36.00
	1.00%	Interbank demand deposits	69.05	69.05	0.00	0.00	0.00	0.00
	2.00%	Mortgages, fixed rate	109.25	8.74	8.74	21.85	34.96	34.96
	2.00%	Interbank demand deposits	67.50	67.50	0.00	0.00	0.00	0.00
		All other assets	225.00	10.00	10.00	55.00	40.00	110.00
-25		Interbank demand deposits						
-125	15%	Retail Demand deposits						
Liabilities	Δ r	Position	Total	[ON, 6M]	(6M, 12M]	(1Y, 2Y]	(2Y, 5]	(5Y, ∞]
	-2.00%	Retail Demand deposits	-106.97	-106.97	0.00	0.00	0.00	0.00
	-2.00%	Interbank demand deposits	-66.28	-66.28	0.00	0.00	0.00	0.00
	-1.00%	Retail Demand deposits	-110.69	-110.69	0.00	0.00	0.00	0.00
	-1.00%	Interbank demand deposits	-57.76	-57.76	0.00	0.00	0.00	0.00
	1.00%	Retail Demand deposits	-139.31	-139.31	0.00	0.00	0.00	0.00
	1.00%	Interbank demand deposits	7.76	7.76	0.00	0.00	0.00	0.00
	2.00%	Retail Demand deposits	-143.03	-143.03	0.00	0.00	0.00	0.00
	2.00%	Interbank demand deposits	16.28	16.28	0.00	0.00	0.00	0.00
		All other liabilities	-250.00	-50.00	-100.00	-50.00	0.00	-50.00
Swap		Receive [fix]	200.00	0.00	0.00	100.00	100.00	0.00
		Pay [floating]	-200.00	-200.00	0.00	0.00	0.00	0.00
				0.5	0.5	1	3	∞
	Δ r	Position		[ON, 6M]	(6M, 12M]	(1Y, 2Y]	(2Y, 5]	(5Y, ∞]
	-2.00%	Periodic gap		-319.49	-78.74	133.15	185.04	
	-2.00%	Cumulative gap		-319.49	-398.23	-265.08	-80.04	
	-2.00%	Δ Nil per bucket		3.19	3.98	5.30	4.80	
	-1.00%	Periodic gap		-316.50	-79.00	132.50	184.00	
	-1.00%	Cumulative gap		-316.50	-79.00	132.50	184.00	
	-1.00%	Δ Nil per bucket		1.58	0.40	-1.33	-5.52	
	1.00%	Periodic gap		-293.50	-81.00	127.50	176.00	
	1.00%	Cumulative gap		-293.50	-81.00	127.50	176.00	
	1.00%	Δ Nil per bucket		-1.47	-0.41	1.28	5.28	
	2.00%	Periodic gap		-290.51	-81.26	126.85	174.96	
	2.00%	Cumulative gap		-290.51	-81.26	126.85	174.96	
	2.00%	Δ Nil per bucket		-2.91	-0.81	2.54	10.50	

Interest rate gap analysis

	Δ Income in next year	
	With position changes	Without position changes
-2.00%	7.18	5.7
-1.00%	1.98	2.85
1.00%	-	1.87
2.00%	-	3.72
		-5.7



Interest rate sensitivity and the interest rate (dollar) gap

Defensive versus aggressive asset/liability management:

- Defensively guard against changes in NII (e.g., near zero gap).
- Aggressively seek to increase NII in conjunction with interest rate forecasts (e.g., positive or negative gaps).
- Many times some gaps are driven by market demands (e.g., borrowers want long-term loans and depositors want short-term maturities).

GAP Summary

GAP	Change in Interest Rates	Change in Interest Income	Change in Interest Expense	Change in Net Interest Income
Positive	Increase	Increase	>Increase	Increase
Positive	Decrease	Decrease	>Decrease	Decrease
Negative	Increase	Increase	<Increase	Decrease
Negative	Decrease	Decrease	<Decrease	Increase
Zero	Increase	Increase	=Increase	None
Zero	Decrease	Decrease	=Decrease	None

Managing the Interest Rate Gap and Earnings Sensitivity Risk

Objective

Approach

Reduce asset sensitivity

Buy longer-term securities.

Lengthen the maturities of loans.

Move from floating-rate loans to term loans.

Put floors on loan rates.

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.

Put caps on deposit rates.

Increase liability sensitivity

Pay premiums to attract short-term deposit instruments.

Borrow more via noncore purchased liabilities.

Simplified example

	Assets	Yield Rates	Liabilities	Interest Costs
Rate sensitive	\$500	6%	\$600	2%
Fixed-rate	350	9	220	4
Nonearning/Nonpaying	150	0	100	0
Total			\$920	
			Equity	
			\$80	
Total	\$1,000		\$1,000	

$$\begin{aligned}
 \text{Net interest income} &= 0.06(\$500) + 0.09(\$350) - 0.02(\$600) - 0.04(\$220) \\
 &= \$61.50 - \$20.80 \\
 &= \$40.70
 \end{aligned}$$

$$\text{Net interest margin} = \$40.70 / \$850 = 4.79\%$$

$$\text{GAP} = \text{RSAs} - \text{RSLs} = \$500 - \$600 = -\$100$$

Expected Changes in Net Interest Income from a Change in (A) the Level of Rates, (B) the Spread, (C) Asset Size (Volume), and (D) Balance Sheet Mix

A. 1% Increase in Level of All Short-Term Rates

	Assets	Yield Rates	Liabilities	Interest Costs
Rate sensitive	\$500	7%	\$600	3%
Fixed-rate	350	9%	220	4
Nonearning/Nonpaying	150		100	
			Equity	
			80	
Total	\$1,000		\$1,000	

$$\begin{aligned} \text{Net interest income} &= 0.07(\$500) + 0.09(\$350) - 0.03(\$600) - 0.04(\$220) \\ &= \$66.50 - \$26.80 \\ &= \$39.70 \end{aligned}$$

$$\begin{aligned} \text{Net interest margin} &= \$39.70/\$850 = 4.67\% \\ \text{GAP} &= \$500 - \$600 = -\$100 \end{aligned}$$

B. 1% Decrease in Spread between Asset Yields and Interest Costs

	Assets	Yield Rates	Liabilities	Interest Costs
Rate sensitive	\$500	6.5%	\$600	3.5%
Fixed-rate	350	9	220	4
Nonearning/Nonpaying	150		100	
			Equity	
			80	
Total	\$1,000		\$1,000	

$$\begin{aligned} \text{Net interest income} &= 0.065(\$500) + 0.09(\$350) - 0.035(\$600) - 0.04(\$220) \\ &= \$64.00 - \$29.80 \\ &= \$34.20 \end{aligned}$$

$$\begin{aligned} \text{Net interest margin} &= \$34.20/\$850 = 4.02\% \\ \text{GAP} &= \$500 - \$600 = -\$100 \end{aligned}$$

Expected Changes in Net Interest Income from a Change in (A) the Level of Rates, (B) the Spread, (C) Asset Size (Volume), and (D) Balance Sheet Mix

C. Proportionate Doubling of Size

	Assets	Yield Rates	Liabilities	Interest Costs
Rate sensitive	\$1,000	6%	\$1,200	2%
Fixed-rate	700	9	440	4
Nonearning/Nonpaying	300		200	
			Equity	
			160	
Total	\$2,000		\$2,000	

Net interest income = $0.06(\$1,000) + 0.091(\$700) - 0.02(\$1,200) - 0.04(\$440) = \$81.40$

Net interest margin = $\$81.40/\$1,700 = 4.79\%$

GAP = $\$1,000 - \$1,200 = -\$200$

D. Increase in RSAs and Decrease in RSLs

	Assets	Yield Rates	Liabilities	Interest Costs
Rate sensitive	\$540	6%	\$560	2%
Fixed-rate	310	9	260	4
Nonearning/Nonpaying	150		100	
			Equity	
			80	
Total	\$1,000		\$1,000	

Net interest income = $0.06(\$540) + 0.09(\$310) - 0.02(\$560) - 0.04(\$260)$

= $\$60.30 - \21.60

= $\$38.70$

Net interest margin = $\$38.70/\$850 = 4.55\%$

GAP = $\$540 - \$560 = -\$20$

Note: RSAs are rate sensitive assets; RSLs are rate sensitive liabilities.

Strengths and Weaknesses of Static Gap Analysis

- Strengths:
 - Easy to understand.
 - Indicates relevant amount and timing of interest rate risk.
 - Suggests magnitudes of portfolio changes to alter risk.
- Weaknesses:
 - Ex-post measurement errors.
 - Ignores the time value of money.
 - Ignores the cumulative impact of interest rate changes.
 - Considers demand deposits to be non-rate sensitive.
 - Ignores embedded options in assets and liabilities.
- IR-gap Divided by Earning Assets as a Measure of Risk:
 - An alternative risk measure that relates the absolute value of a bank's gap to earning assets.
 - The greater this ratio, the greater the interest rate risk.
 - Banks may specify a target gap-to-earning-asset ratio in their ALCO policy statements.
 - A target allows management to position the bank to be either asset sensitive or liability sensitive, depending on the outlook for interest rates.

Earnings Sensitivity Analysis

- Extends static gap analysis by making it dynamic.
 - Model simulation or what-if analysis of all factors that affect net interest income across a wide range of potential interest rate environments.

- Steps to Earnings 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 money and hence, exercised under the assumed interest rate environment.
 4. Identify when specific assets and liabilities will reprice given the rate environment.
 5. Estimate net interest income and net income under the assumed rate environment.
 6. Repeat the process to compare forecasts of net interest income and net income across different interest rate environments versus the base case.

The choice of base case is important because all estimated changes in earnings are compared with the base case estimate.

Duration gap analysis

How do changes in interest rates affect asset, liability, and equity values?

In general, $\Delta V = -D \times V \times [\Delta i / (1 + i)]$

For assets: $\Delta A = -D \times A \times [\Delta i / (1 + i)]$

For liabilities: $\Delta L = -D \times L \times [\Delta i / (1 + i)]$

Change in equity value is: $\Delta E = \Delta A - \Delta L$

DGAP (duration gap) = $D_A - W D_L$, where D_A is the average duration of assets, D_L is the average duration of liabilities, and W is the ratio of total liabilities to total assets.

DGAP can be positive, negative, or zero.

The change in net worth or equity value (or ΔE) here is different from the market value of a bank's stock (which is based on future expectations of dividends). This new value is based on changes in the market values of assets and liabilities on the bank's balance sheet.

Duration gap analysis

EXAMPLE: Balance Sheet Duration

Assets	€	Duration (yrs)	Liabilities	€	Duration (yrs)
Cash	100	0	CD, 1 year	600	1.0
Business loans	400	1.25	CD, 5 year	<u>300</u>	<u>5.0</u>
			Total liabilities	900	2.33
Mortgage loans	<u>500</u>	<u>7.0</u>	Equity	<u>100</u>	
	€1,000	4.0		€1,000	

$$\text{DGAP} = 4.0 - (.9)(2.33) = 1.90 \text{ years}$$

Suppose interest rates increase from 11% to 12%. Now,

$$\% \Delta E = (-1.90)(0.01/1.11) = -1.7\%$$

$$\text{€ } \Delta E = -1.7\% \times \text{total assets} = 1.7\% \times \$1,000 = -\text{€}17.$$

Alternatively, the change in asset values = $-4 \times \text{€}1000 \times 0.01/1.11 = -\text{€}36.04$
 and the change in the value of liabilities = $-2.33 \times \text{€}900 \times 0.01/1.11 = -\text{€}18.89$
 such that $\Delta E = \Delta A - \Delta L = -\text{€}36.04 + \text{€}18.89 = -\text{€}17.14$

Duration gap analysis

- Defensive and aggressive duration gap management:
 - If you assume interest rates will decrease in the future, a positive duration gap is desirable - as rates decline, asset values will increase more than liability values increase (a positive equity effect).
 - If you predict an increase in interest rates, a negative duration gap is desirable -- as rates rise, asset values will decline less than the decline in liability values (a positive equity effect).
 - Of course, zero gap protects equity from the valuation effects of interest rate changes -- defensive management.
 - Aggressive management adjusts duration gap in anticipation of interest rate movements.

DGAP	Change in Interest Rates	Change in Economic (Market) Value				
		Assets		Liabilities		Equity
Positive	Increase	Decrease	>	Decrease	→	Decrease
Positive	Decrease	Increase	>	Increase	→	Increase
Negative	Increase	Decrease	<	Decrease	→	Increase
Negative	Decrease	Increase	<	Increase	→	Decrease
Zero	Increase	Decrease	=	Decrease	→	None
Zero	Decrease	Increase	=	Increase	→	None

Duration gap analysis

0: Given is the following balance sheet:

Note that all instruments are at par.		Rate	Markt value	Assets	Liabilities	Markt value	Rate
				100.0	Cash	Term deposit, 1Y	620.0
	12.00%	700.0	Commercial loan, 3Y	Senior unsecured corporate bond issue, 3Y	300.0	7.00%	
	8.00%	200.0	Treasury bond, 6Y	Equity	80.0		
		1000	Σ	Σ	1000		

1: Compute the duration of the positions:

Position	Coupon	Cash flows x Time buckets						
		0	1	2	3	4	5	6
Cash		100.0						
3y-commercial loan	12%	700.0	84.0	84.0	784.0	0.0	0.0	0.0
Treasury bond, 6Y	8%	200.0	16.0	16.0	16.0	16.0	16.0	216.0
Term deposit, 1Y	5%	620.0	651.0					
Senior unsecured corporate bond	7%	300.0	21.0	21.0	321.0			

Position	Present values x Time buckets							yield	NPV(yield)	Mod Duration [y]	PV
	0	1	2	3	4	5	6				
Cash	-100.0	100.0						0.00	0.00	0.00	100.0
3y-commercial loan	-700.0	75.0	67.0	558.0	0.0	0.0	0.0	12.00%	0.00	2.69	700.0
Treasury bond, 6Y	-200.0	14.8	13.7	12.7	11.8	10.9	136.1	8.00%	0.00	4.99	200.0
Term deposit, 1Y	-620.0	620.0	0.0	0.0	0.0	0.0	0.0	5.00%	0.00	1.00	620.0
Senior unsecured corporate bond	-300.0	19.6	18.3	262.0	0.0	0.0	0.0	7.00%	0.00	2.81	300.0

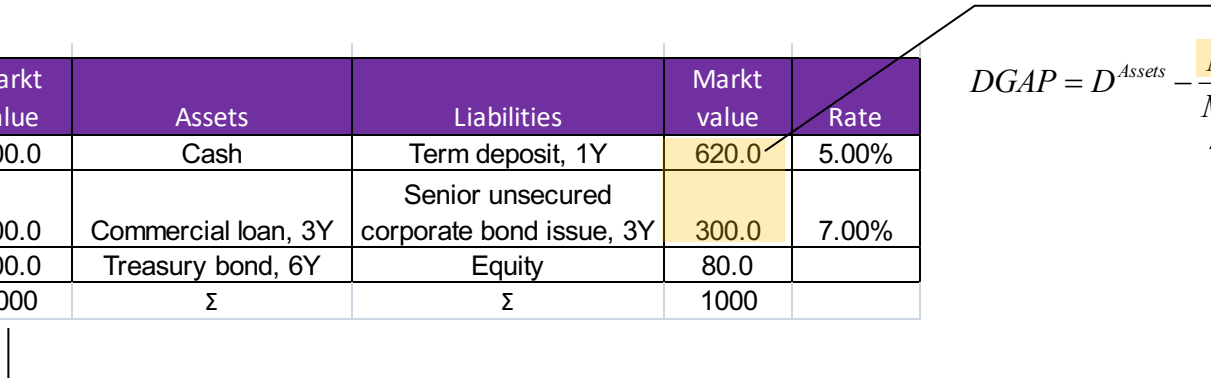
Duration gap analysis

2: Compute the duration gap:

				Weighted duration of assets:	2.88 years
				Weighted duration of liabilities:	1.59 years
				Duration gap (DGAP):	1.42 years

Rate	Markt value	Assets	Liabilities	Markt value	Rate
	100.0	Cash	Term deposit, 1Y	620.0	5.00%
12.00%	700.0	Commercial loan, 3Y	Senior unsecured corporate bond issue, 3Y	300.0	7.00%
8.00%	200.0	Treasury bond, 6Y	Equity	80.0	
	1000	Σ	Σ	1000	

$$DGAP = D^{Assets} - \frac{MV^{Liab.}}{MV^{Assets}} \cdot D^{Liabs.}$$



An Immunized Portfolio

Objective: Reduce Interest Rate Risk with $DGAP > 0$:

- Shorten asset durations by:
 - Buying short-term securities and selling long-term securities.
 - Making floating-rate loans and selling fixed-rate loans.
- Lengthen liability durations by:
 - Issuing longer-term CDs.
 - Obtaining more core transactions accounts from stable sources.
- Lengthen asset durations by:
 - Buying long-term securities and selling short-term securities.
 - Buying securities without call options.
 - Making fixed rate loans and selling floating-rate loans.
- Shorten liability durations by:
 - Issuing shorter-term CDs.
 - Using short-term purchased liability funding from federal funds and repurchase agreements.

Immunized Portfolio

Bank Balance Sheet: DGAP = 0

Assets	Market Value	Rate	Duration	Liabilities and Equity	Market Value	Rate	Duration
Cash	\$100			1-yr. time deposit	\$340	5%	1.00 yr.
3-yr. commercial loan	700	12%	2.69 yrs.	3-yr. certificate of deposit	300	7	2.81
6-yr. Treasury bond	200	8	4.99	6-yr. zero coupon CD*	280	8	6.00
			2.88 yrs.	Total liabilities	\$920		3.11 yrs.
				Equity	\$80		
Total	\$1,000				\$1,000		

$$DGAP = 2.88 - 0.92(3.11) \cong 0$$

1% Increase in All Rates

Cash	\$100			1-yr. time deposit	\$337	6%	1.00 yr.
3-yr. commercial loan	683	13%	2.68 yrs.	3-yr. certificate of deposit	292	8	2.80
6-yr. Treasury bond	191	9	4.97	6-yr. certificate of deposit	265	9	6.00
			2.86 yrs.	Total liabilities	\$894		3.07 yrs.
				Equity	\$80		
Total	\$974				\$974		

*Par (maturity) value = \$444.33

Strengths and Weaknesses: DGAP and EVE Sensitivity Analysis

— Strengths:

- Duration analysis provides a comprehensive measure of interest rate risk for the total portfolio.
- Duration measures are additive so that total assets may be matched with total liabilities rather than matching of individual accounts.
- Duration analysis takes a longer-term view and provides managers with greater flexibility in adjusting rate sensitivity because they can use a wide range of instruments to balance value sensitivity.

— Weaknesses:

- It is difficult to compute duration accurately.
- “Correct” duration analysis requires that each future cash flow be discounted by a distinct discount rate.
- A bank must continuously monitor and adjust the duration of its portfolio.
- It is difficult to estimate the duration on assets and liabilities that do not earn or pay interest.
- Duration measures are highly subjective.

Literature

- CHOUDRY M. (2022). The Principles of Banking, 2nd ed. – Chapter 5.
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