Interest Rate Risk **= ∂margin / ∂ r = ∂profitability / ∂r**

risk of loss due to an unfavourable change in interest rates

Causes of Interest Rate Risk

- ◊ *Maturity mismatch* b/w A and L
- ◊ *Repricing mismatch* (resetting interest rates)

Δr -> Δ value sec on both sides of BS. This could create a loss because it affects A & L in f(Maturity)

ex: 6mo T-Bill -> rate is reset √ 6mo

ex: variable mortgage loan: 2 yrs mortgage with int rates reset √ 2mo => value of Loan Δ √ 2mo

Refinance position

Loans (fixed)		Deposits	
1 yr @ 6%	50	1 yr Loan @ 4%	100
2 yr @ 7 %	50		

L/T S/T => mismatch

1 yr later

Loans (fixed)		Deposits	
		1 yr Loan @ rr	50
2 yr @ 7 %	50	rr = refinance rate (unknown)	

=> *refinance position*: borrow S/T (L)
lend L/T (A)

RSL position
concern is Δr>0 => Margin < 0
GAP < 0 = Short Funded BNK
DGAP > 0

Reinvestiment position

Loans (fixed)		Deposits	
1 yr @ 6%	50	2 yr Loan @ 5%	100
2 yr @ 7 %	50		

S/T L/T

1 yr later

Loans (fixed)		Deposits	
1 yr Loan @ rr	50	2 yr Loan @ 5%	50
2 yr @ 7 %	50		

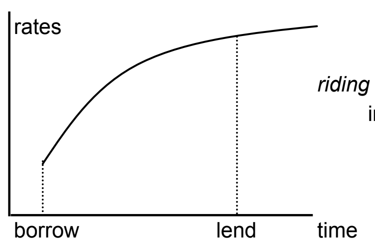
rr = reinvestiment rate (unknown)

=> *reinvestiment position*: lend S/T (A)
borrow L/T (L)

RSA position
concern is Δr<0 => Margin < 0
GAP > 0 = Long Funded BNK
DGAP < 0

Which position should a BNK take?

based on the yield curve



riding the yield curve to maximize Profit +> refinance position
in contraddiction with safety rules => safety violation

S/T rates (L) L/T rates (A)

properties of rate-price relationship

∂B / ∂r < 0
∂∂B / ∂r ∂mat > 0
∂∂∂B / ∂r ∂∂mat < 0

Maturity GAP model

focuses on accounting approach on B/S
main concern is the value of Equity

Mat(A) = wi Mat(A)i
Mat(L) = wi Mat(L)i
Mat(GAP) = MGAP = Mat(A) - Mat(L) : = 0

weaknesses

doesn't account for leverage
ignore timing of CF
based on accounting approach

Paolo Nalin paolo.nalin@mail.mcgill.ca www.nalin.ca

Funding GAP / Repricing GAP / GAP Method / Interest Rate GAP

RSA = Rate Sensitive Asset — Asset that will be repriced in <= 1 yr
RSL = Rate Sensitive Liability — Liability that will be repriced in <= 1 yr
FRA = Fixed Rate Asset — Asset that will be repriced in > 1 yr
FRL = Fixed Rate Liability — Liability that will be repriced in > 1 yr

GAP Method consists in grouping A/L into different time intervals based on repricing dates
GAP i = RSAi - RSLi   i=1dd, 3dd, …   it is the dollar size of gap b/w book value of A and L in maturity bucket I
CGAP = ∑ Period GAPi   *Cumulative GAP* over the whole year

Δ NII = ∑ GAP i * Δr i = ∑(RSA i - RSL i) * Δr i   i=1dd, 3dd, …
Δ NII = CGAP * Δr

main concern is on Net Interest Income

GAP > 0 <=> RSA > RSL => RSA Position   -> reinvestiment position
Δr > 0 => Δ NII > 0   revenues increase faster than expenses
Δr < 0 => Δ NII < 0   revenues decreasing faster than expenses

GAP < 0 <=> RSA < RSL => RSL Position   -> refinincing position
Δr > 0 => Δ NII < 0   expenses are increase faster than revenues
Δr < 0 => Δ NII > 0   expenses are decreasing faster than revenues

CGAP ratio = CGAP / Assets   to measure interest rate risk
provides direction and scale of exposure
higher ratio => higher risk

Example

RSA	1 yr	Loan	50	DD		40	Sticky	**Note: RSA is NET Loan**
FRA	2 yr	Loan	25	Savings		30	Sticky	
RSA	3 mo	T-Bill	65	3 mo	CD	40 RSL		
FRA	3 yr	T-Bonds	70	6 mo	CP	80 RSL		
FRA	10 yr	Fx-r Mtg	20	1 yr	TDep	20 RSL		
RSA	30 yr	V-r Mtg	40	2 yr	TD	40	FRL	
				Equity		20	FRL	

V-r = variable rate √6mo

RSA 155
RSL 140

	GAPi		ΔNII (Δ r = 1%)	
3mo	25	mln	0.25	mln
6mo	-40	mln	-0.40	mln
1yr	30	mln	0.30	mln

CGAP 15
Δ NII 0.15   => note: ΔNII 3mo > ΔNII 1yr   CGAP ratio 5.6%

if changes in rates on RSAs and RSLs are not equal Δ NII = RSA Δr(RSA) - RSL Δr(RSL)

Example

RSA 155   NII = 0.46
RSL 140
Δr (RSA) 1.2%
Δr (RSL) 1.0%

Advantages of the Model	Disadvantages
◊ simple	◊ ignore MKT value effects and off-BS CF
◊ Flexible	◊ Overaggregate information over the time interval
◊ Allows for any shift in the yield curve	◊ Ignore sensitivity of runoffs to interest rates

=> large BNKs repice L & A every day

Paolo Nalin   paolo.nalin@mail.mcgill.ca   www.nalin.ca

Duration GAP: another measurement of Interest Rate risk
This model focuses on MKT value perspective

$\Delta r>0 \Rightarrow$ $\Delta A < 0$
$\Delta L < 0$

if $|\Delta A <0| > |\Delta L<0| \Rightarrow \Delta E<0$ -> interest rate could collapse an institution

the longer the Maturity, the higher the interest rate risk

$$D = \frac{1}{B} \sum t \frac{CFt}{(1+r)^t}$$ Macaulay Duration [yrs]

Duration can be summed across portfolios of securities

$DA = \sum wA * DA$
$DL = \sum wL * DL$

DA	A1	L1	DL
	A2	L2	
	A3	L3	

$\Delta A = -DA * A * \Delta r/1+r$
$\Delta L = -DL * L * \Delta r/1+r$

$\Delta E = -(DA * A * \Delta r/1+r) - (-DL * L * \Delta r/1+r)$

Immunizing the B/S <= $\Delta E = 0$

Assuming $\Delta rA = \Delta rL$ (not always true)

$\Delta E = - [DA - DL * L/A] * A * \Delta r/1+r$
[DA - DL * L/A] = **Leverage Adjusted Duration GAP := DGAP**
A = **Size**
$\Delta r/1+r$ = **Interest Rate Shocks**

=> there are three elements to watch

Duration Gap is NOT
- The interest rate GAP — important on B/S
- the Financing Gap — from Liquidity Risk

Advantages	Disadvantages	
one number tells all	Duration is static	
easy calculation	Assume flat TS	
theoretically sound	Assume Parallel Shifts	
	Does not reflects	Convexity
		Default Risk

Paolo Nalin paolo.nalin@mail.mcgill.ca www.nalin.ca

Example

	Cash	100	1yr CD	5%	620	find ΔE if Δr= 1%
6yr GvT Sec	8%	200	3yr CD	7%	300	
3yr Loan @	12%	700	(Annual Payments)			
(interest only loan)			Equity		80	

DA	D(cash)	0	w1	0.10
	D(Gvt Bond)	4.99	w2	0.20
	D(3yrs Loan)	2.69	w3	0.70
DL	D(1yr CD)	1	w1	0.67
	D(3yr CD)	2.81	w2	0.33

DA	2.88	A	1000	
DL	1.59	L	920	
DGAP	1.42	Δr	1%	
		r	0.100	av rates on assets
		r/(1+r)	0.009	int rates shock
ΔE	-12.90			

same exercise in the case rA =/= rL

ΔA	-26.2		rA	0.100
ΔL	-13.84		rL	0.057
ΔE	-12.35	= ΔA - ΔL		=> even adjusting the assumptions, there isn't a major change

Example

3 yrs	0.10 Cr	100	1 yrs	0.10 Cr	90	
annual, sold at ytm=		0.10	annual, sold at ytm=			0.10
			Equity		10	

dr(A)=	0.01 ->	A=		97.56	
dr(L)=	0.01 ->	L=		89.19	
		E=		8.37	
	ΔA	(2.44)	-2.44%		
	ΔL	(0.81)	-0.90%		
	ΔE	(1.63)	-16.33%		Equity is exposed to interest rate
dr(A)=	0.07 ->	A =		84.53	
dr(L)=	0.07 ->	L =		84.62	
		E=		(0.08)	

Maturity Matching

3 yrs	0.05 Cr	100	3 yrs	0.05 Cr	90	
annual, sold at ytm=		0.12	annual, sold at ytm=			0.09
			Equity		10	

dr(A)=	0.01 ->	A =		81.11	
dr(L)=	0.01 ->	L =		78.81	
		E=		2.30	
	ΔA	(18.89)	-18.89%		
	ΔL	(11.19)	-12.43%		
	ΔE	(7.70)	-76.98%		Equity is still exposed to interest rate