

Introduction

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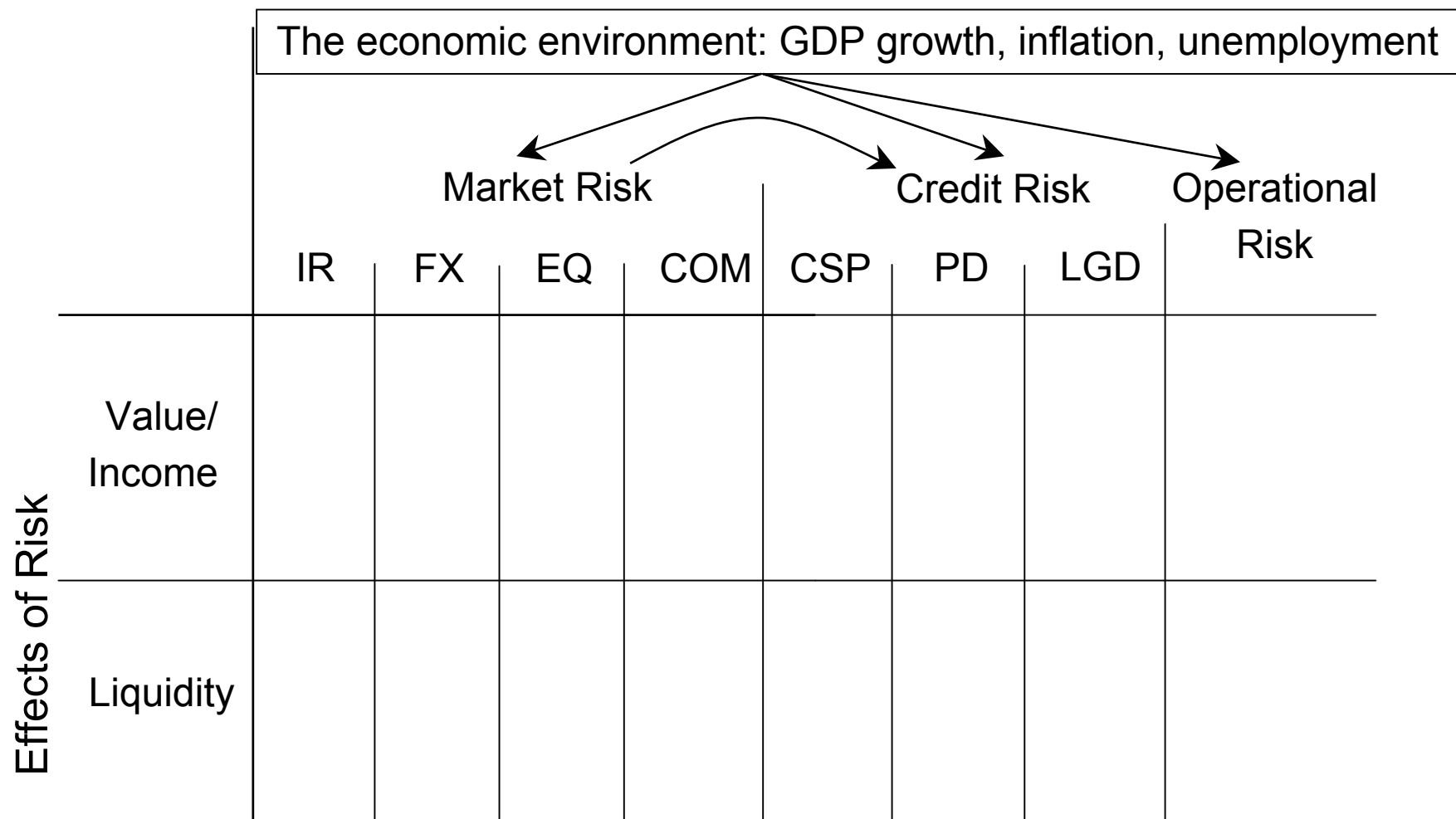
- Definitions
- The benefit of integrated financial analysis
- Basics of market risk analysis

- Market Risk 1: Potential negative effect of any market condition (interest rate, FX-rate, stock market) on the trading position
- Market Risk 2: Potential negative effect of any market condition (interest rate, FX-rate, stock market) on the bank as a whole

- ALM 1: Management of the interest rate risk of a bank (usually trading and banking book)
- ALM 2: Management of all market risks of a bank (usually trading and banking book)
- ALM 2: ... expanding
 - FTP
 - IFRS
 - Etc.

- Risk Controlling 1: Controlling the activities of market risk and ALM (and others)
- Risk Controlling 2: Similar function like ALM

Sources of Risk



- Definitions
- **The benefit of integrated financial analysis**
- Basics of market risk analysis

- A private bank with 5 Bio. EUR bought the system for about 2.5 Mio. EUR (interface and software)
- To this point, market risks was strictly avoided, due to the lack of control
- The bank was advised (by McKinsey) to take market risk positions, thanks to the strong capital basis
- The bank organized a special profit center for market risk (Management and control)
- The pay back period was less than 1 month



2006-05-22: Thirty percent of respondents surveyed said that regulatory compliance was the single biggest issue their organizations are dealing with, followed closely by industry competition (29 percent). Not surprisingly, given the focus on regulatory compliance ...

The cost of regulation is strongly linked to the level of organization in the risk management area.

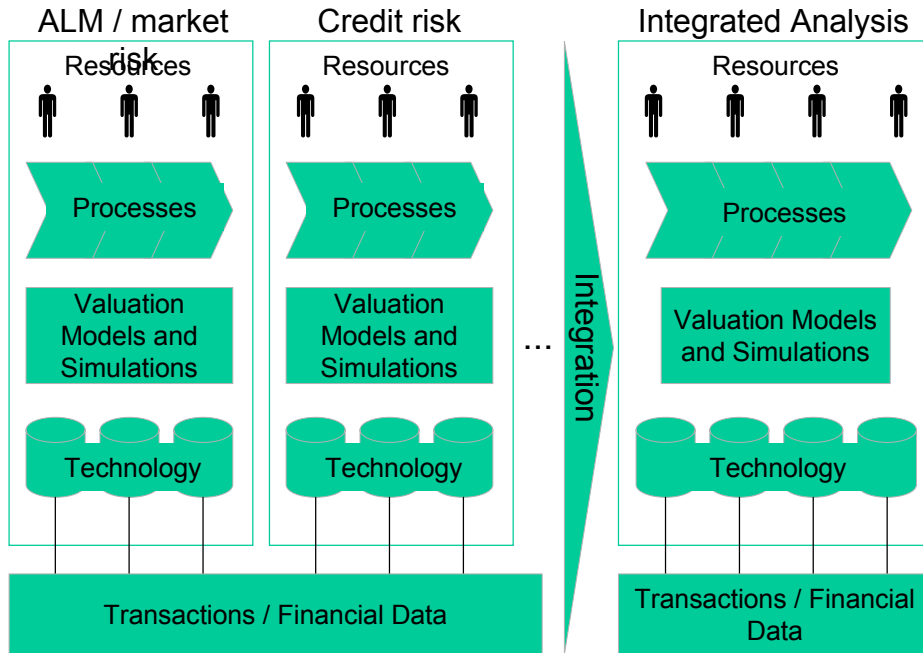
- BayernLB got highest ranking in „Pfandbriefe“ thanks to quality of underlying but also because they could prove the rating agency, that they can control the risks of the issue.

See http://www.bayernlb.de/p/_de/idx/invest1/invest8/invest8.jsp

- What is the value of understanding well what you are doing?
- What is the value of having one single view?
- What is the value of avoiding bankruptcy?

Potential value contribution of an integrated risk and profitability analysis

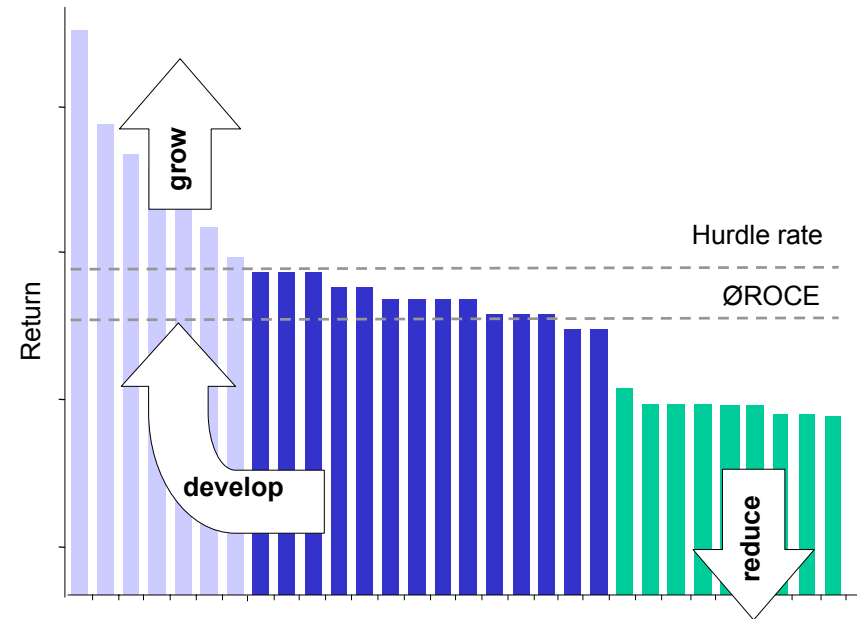
Cost Lever



25% - 30% reduction of current cost of analysis

Source: Accenture research, project experience

Focus / Growth Lever

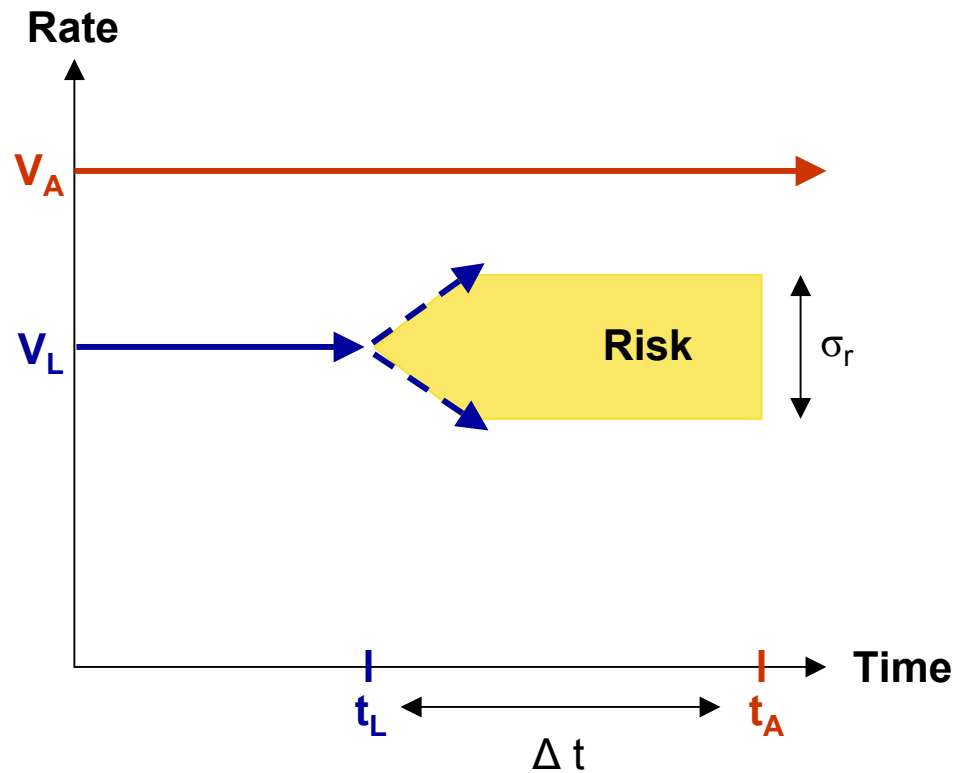


Up to 90 bps increase of return

- Definitions
- The benefit of integrated financial analysis
- **Basics of market risk analysis**

Duration, Convexity, and Related Measures

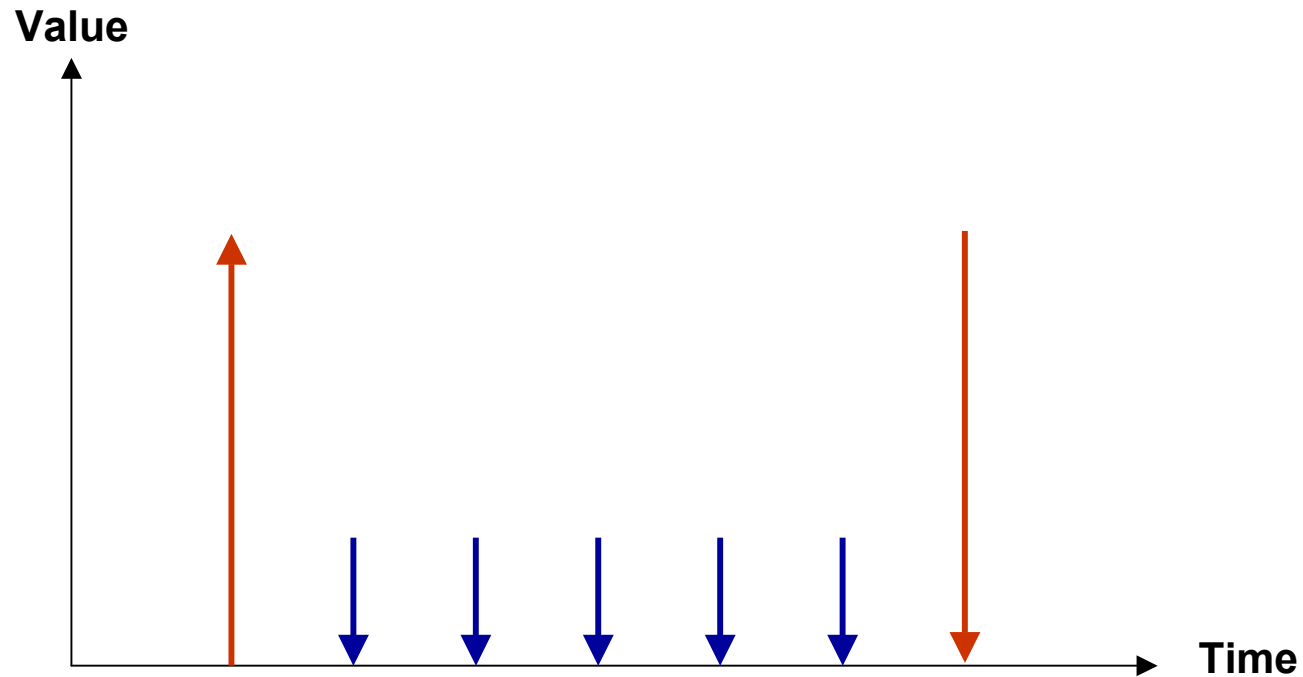
1. Measuring risk via Gap
2. Duration & Convexity provide alternate views
3. Key Rate Duration combines Gap & Duration
4. VaR takes σ_r into account



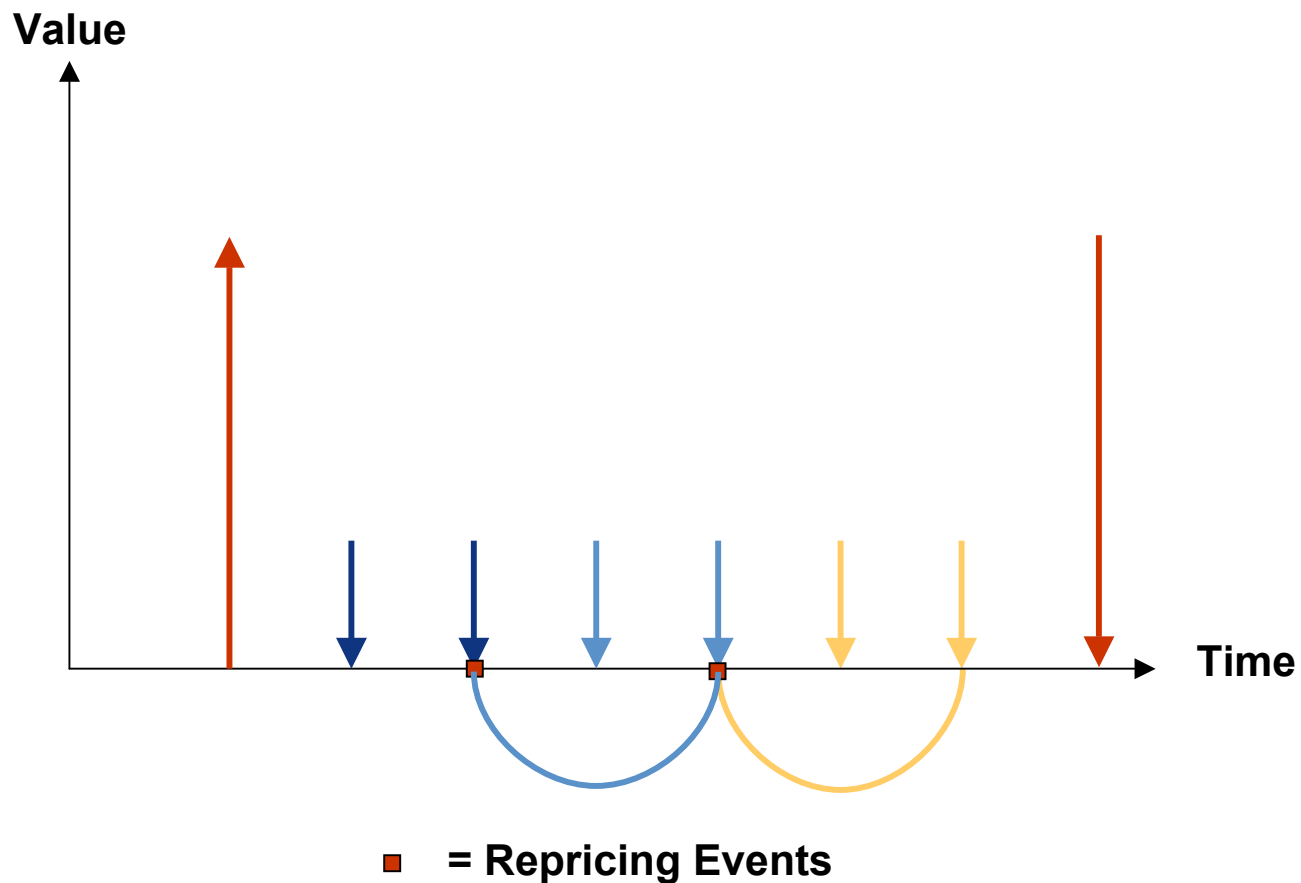
The 2 main dimensions of interest rate risk are:

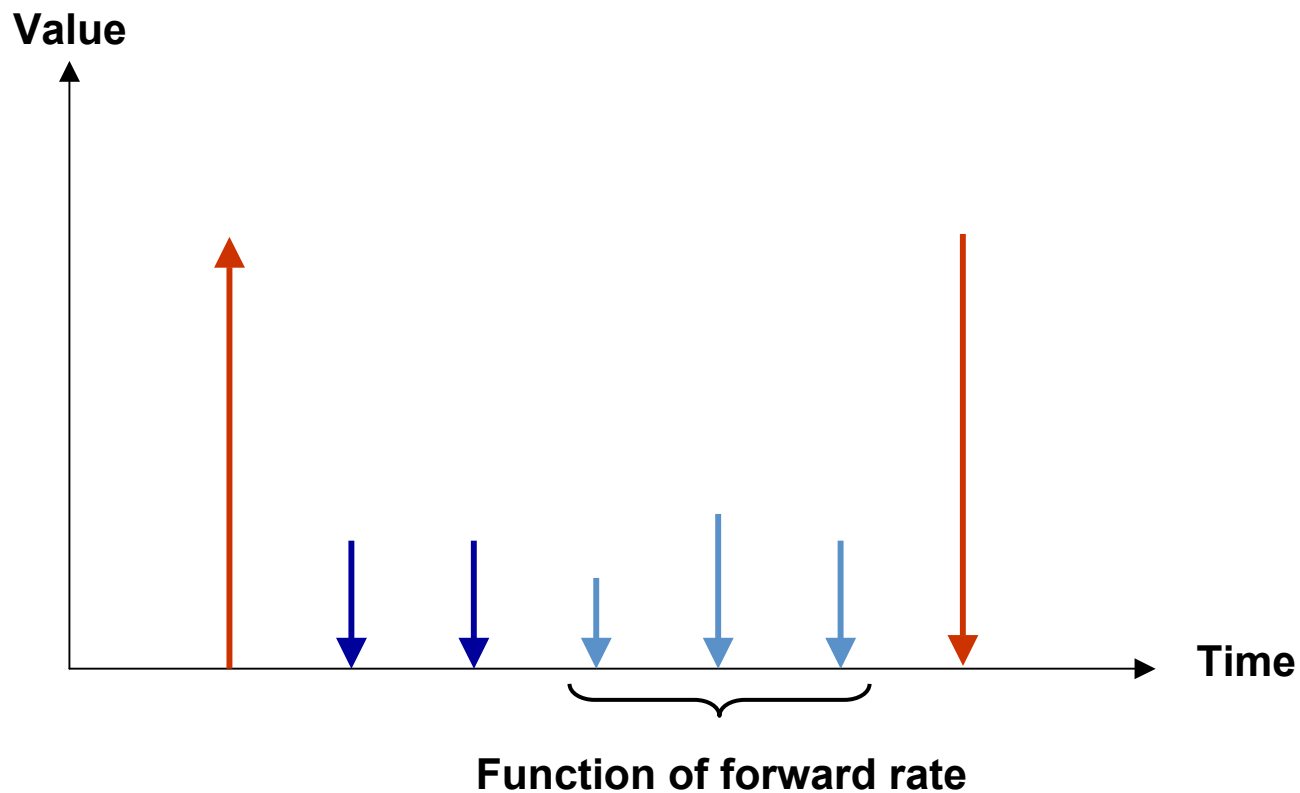
- Δt
- σ_r

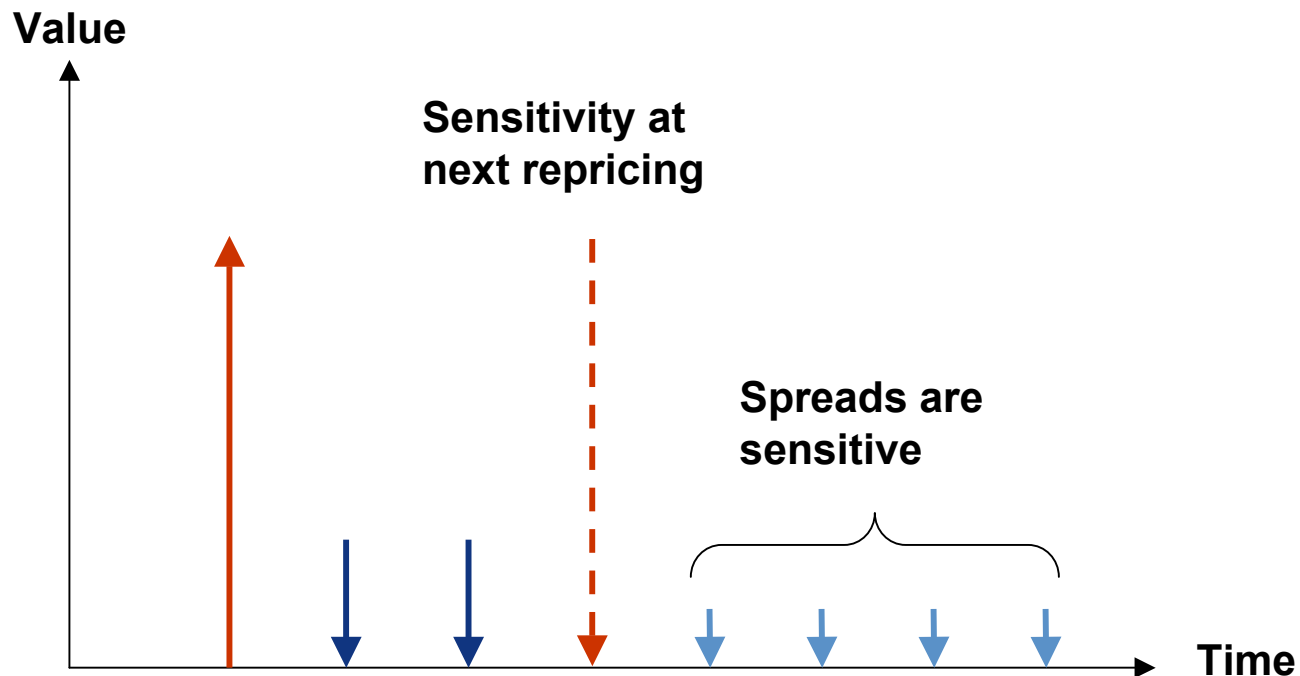
- Liquidity measures effective liquidity flows
- Liquidity measures only Δt ; σ_r plays a minimal role
- Sensitivity measures time to repricing
- Like Liquidity, Sensitivity measures Δt . However, σ_r is taken intuitively into account.



Liquidity and Sensitivity Gap are equal

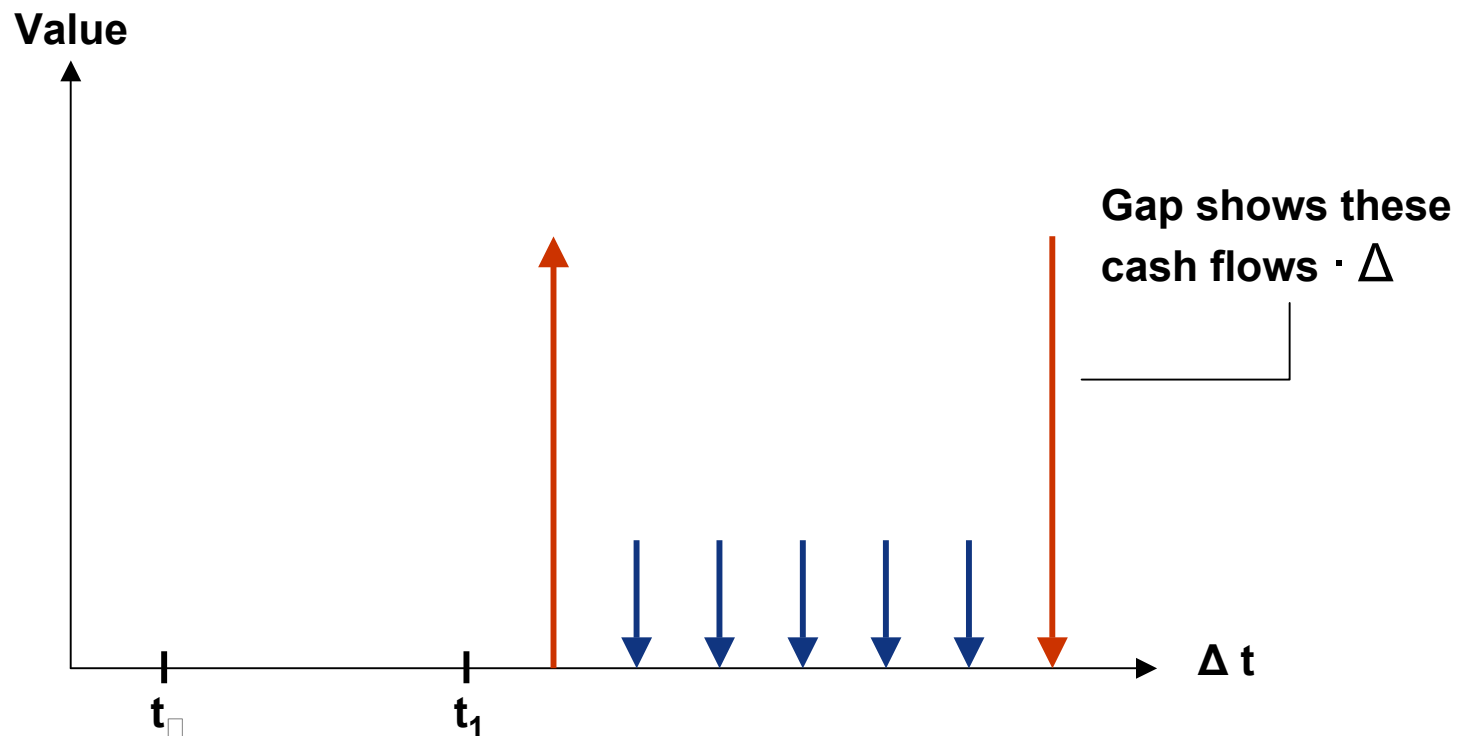




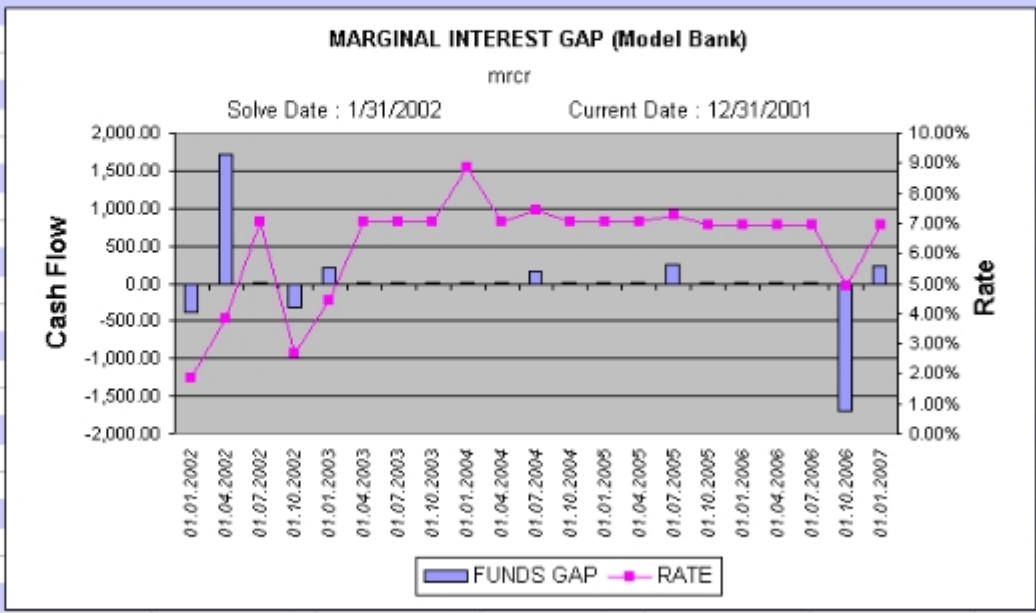


- Liquidity Gap: Forward pay off
- Sensitivity Gap: Δ weighted sensitivity flows of the underlying

- Option type: Buy/call
- Underlying instrument: 5 year bond
- Strike price: x
- Strike date: t_1



1	2	3	4	5	ABC	DE	FG	H	I	J	K	L	O	P	Q	R	S	T	U	V	
	2	Interval											NOMINAL VALUE	1.1.2002 - 31.3.2002	1.4.2002 - 30.6.2002	1.7.2002 - 30.9.2002	1.10.2002 - 31.12.2002	1.1.2003 - 31.3.2003	1.4.2003 - 30.6.2003	1.7.2003 - 30.9.2003	
	7	Model Bank											379.94								
	8	FUNDS GAP												-377.86	1,716.77	16.80	-315.17	206.85	16.88	16.90	
	9	RATE												1.86%	3.83%	7.04%	2.70%	4.44%	7.04%	7.04%	
	10	Balance Sheet											382.63								
	11	FUNDS GAP												-377.86	16.77	16.80	-315.17	206.85	16.88	16.90	
	12	RATE												1.86%	7.04%	7.04%	2.70%	4.44%	7.04%	7.04%	
	13	Assets											1,264.64								
	14	FUNDS GAP																			16.90
	15	RATE																			7.04%
	16	Liquidity											52.00								0.00
	17	FUNDS GAP																			0.00
	18	RATE																			0.00
	19	Interbank											248.00								0.00
	20	FUNDS GAP																			0.00
	21	RATE																			0.00
	22	Short term											58.00								0.00
	23	FUNDS GAP																			0.00
	24	RATE																			0.00
	25	Long term											190.00								0.00
	26	FUNDS GAP																			0.00
	27	RATE																			0.00
	28	Loans											774.63								16.90
	29	FUNDS GAP																			7.04%
	30	RATE																			12.63
	31	Retail											475.00								6.95%
	32	FUNDS GAP																			
	33	RATE																			
	34	Corporate											299.64								
	35	FUNDS GAP												4.28	4.29	4.29	4.29	4.28	4.28	4.27	
	36	RATE												7.30%	7.30%	7.30%	7.30%	7.30%	7.30%	7.30%	
	37	Investment portfolio											190.00								



Duration, Convexity, and Related Measures

1. Measuring risk via Gap
2. Duration & Convexity provide alternate views
3. Key Rate Duration combines Gap & Duration
4. VaR takes σ_r into account

- Gap is both intuitive and not intuitive
- Gap analyses can be difficult to interpret because the results often consist of multiple numbers
- Duration is a vehicle for distilling a Gap analysis into one value
- Duration measures Δt

McCauley's objective was to develop a unified measure of term

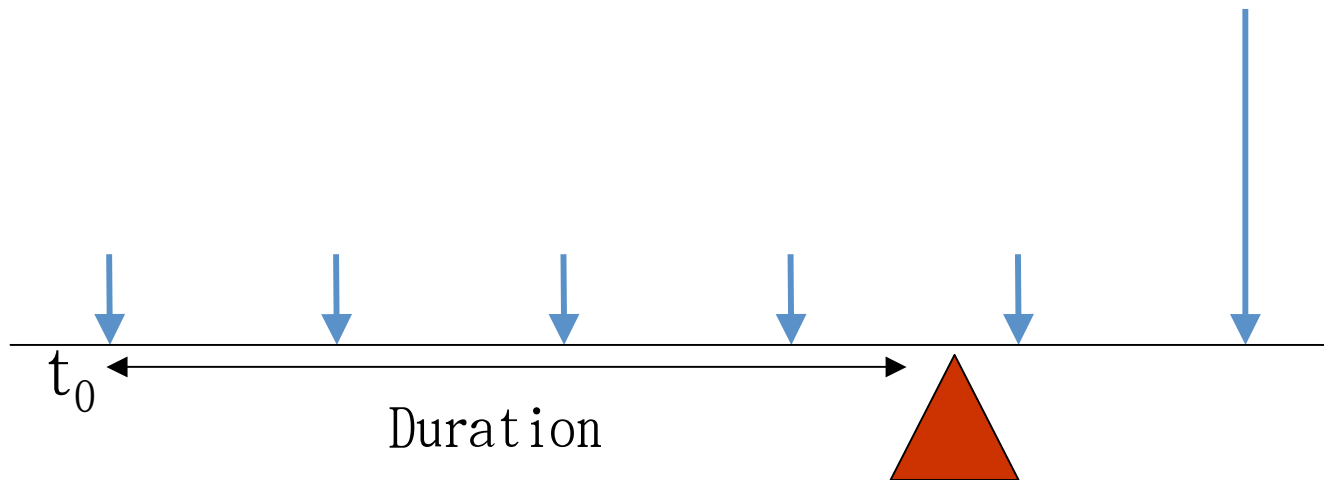
$$\frac{\sum t \cdot \text{NPV}(\text{CFL}_t, \text{internal rate of return})}{\text{NPV}(\text{internal rate of return}) \text{ of bond}}$$

McCauley did not realize the importance of his discovery!

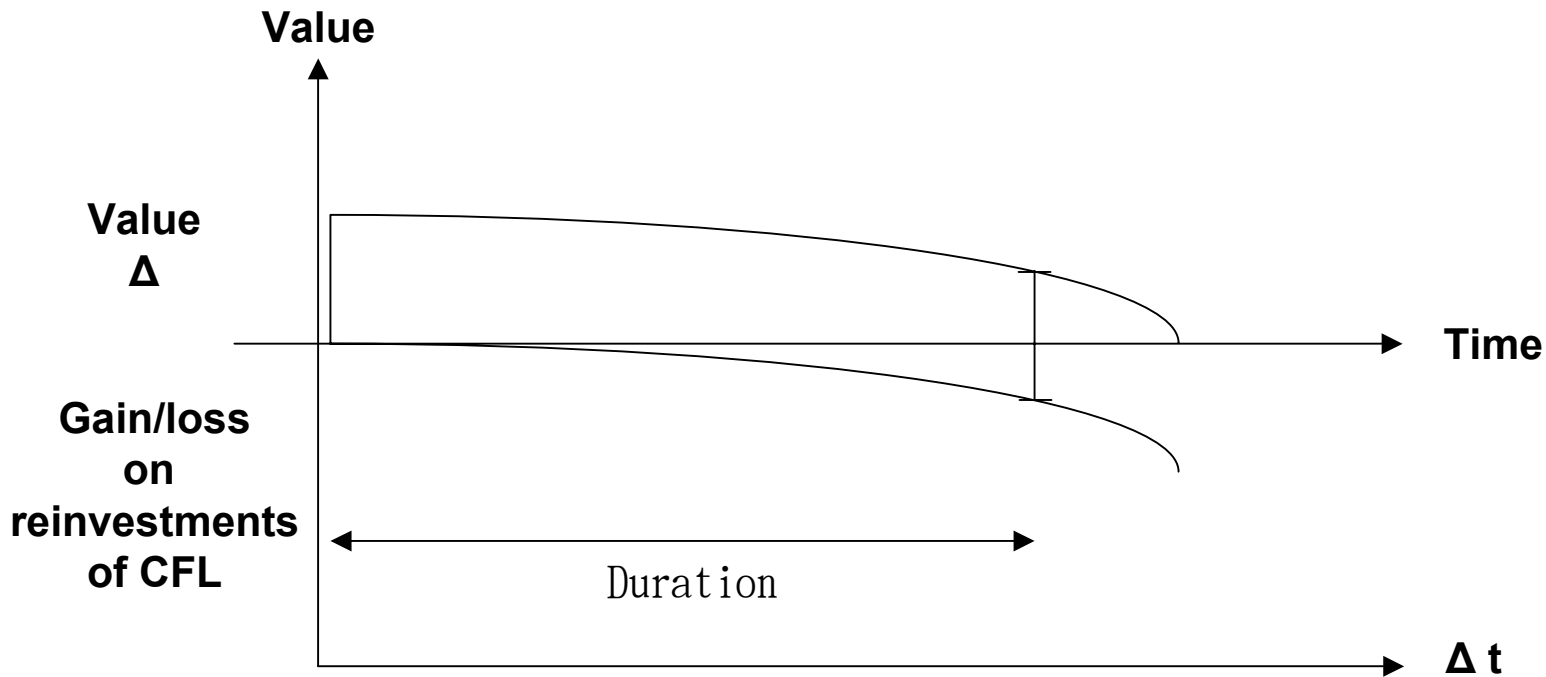
$$\frac{\sum -t \cdot CFL_t \cdot e^{-r_t t}}{\sum CFL_t e^{-r_t t}}$$

Weil's contribution: this definition takes market conditions into account and can handle full yield curves

NPV-weighted time
(a kind of average gap)



Hedge Investment Horizon: point in time in which the value of a portfolio can be (almost) 100% achieved.

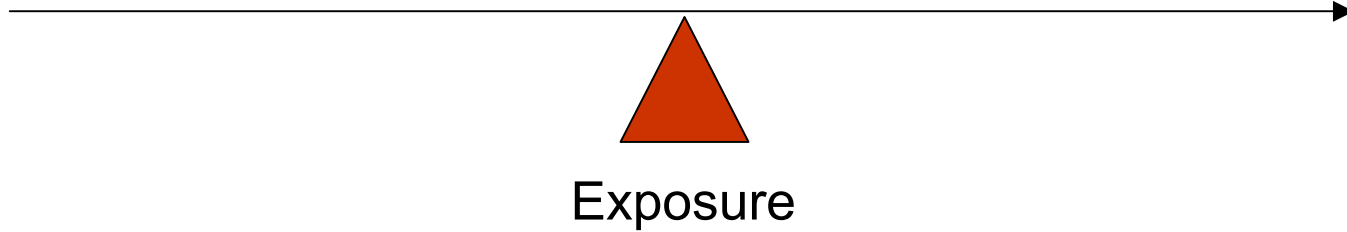


Relative Sensitivity of NPV to interest rate changes.

$$\frac{\frac{dNPV}{dr}}{NPV}$$

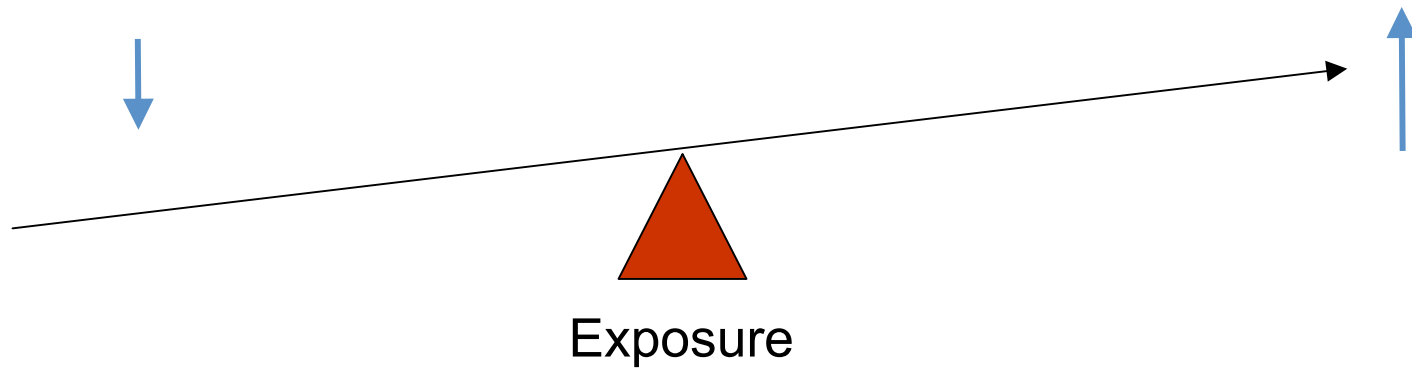
Interest Rate

Value



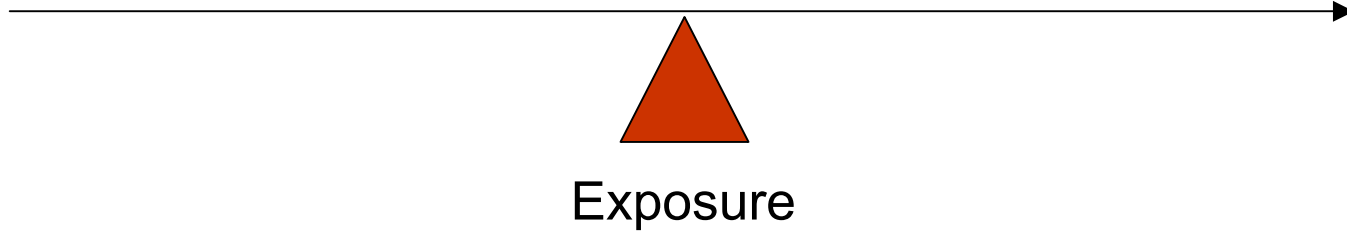
Interest Rate

Value



Interest Rate

Value



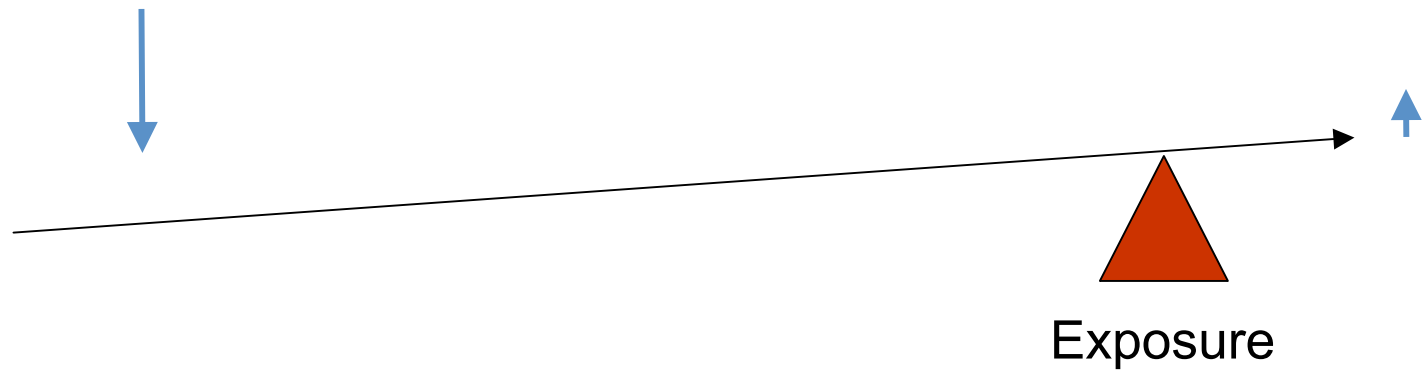
Interest Rate

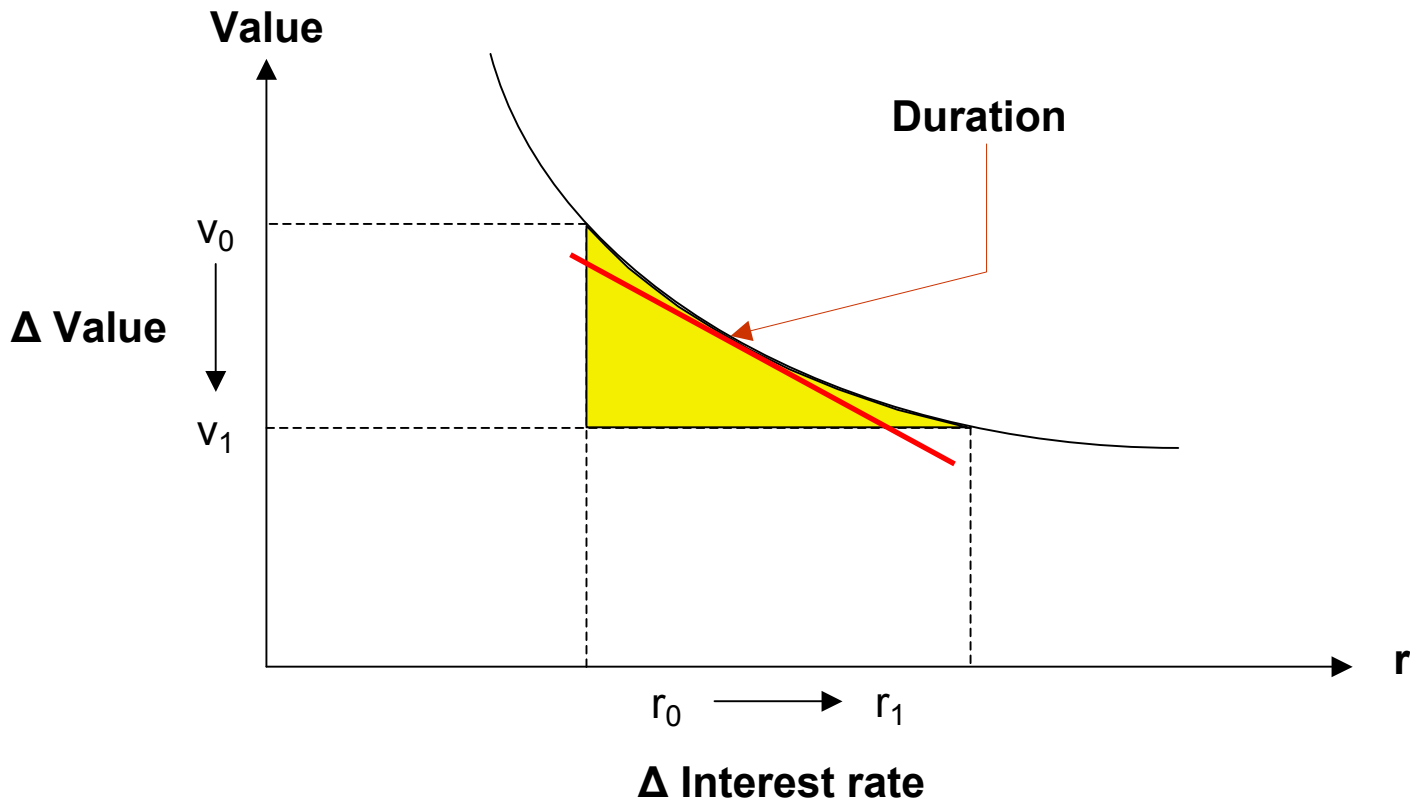
Value



Interest Rate

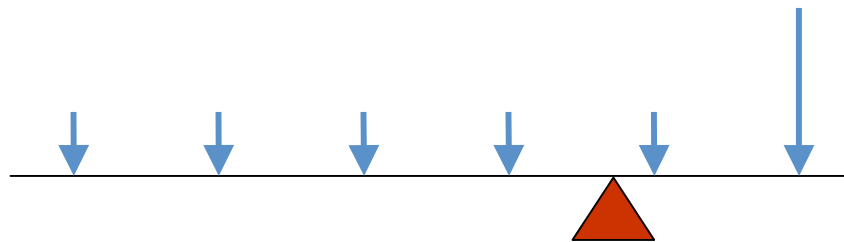
Value





- Duration shrinks gap to one number
- This has advantages and disadvantages
- Duration can be interpreted as “average gap”

NPV-weighted time



$$DUR_{EQ} = \frac{DUR_{AS} \cdot NPV_{AS} - DUR_{LB} \cdot NPV_{LB}}{NPV_{AS} - NPV_{LB}}$$

$$DUR_{EQ} = \frac{\$DUR_{AS} - \$DUR_{LB}}{NPV_{EQ}}$$

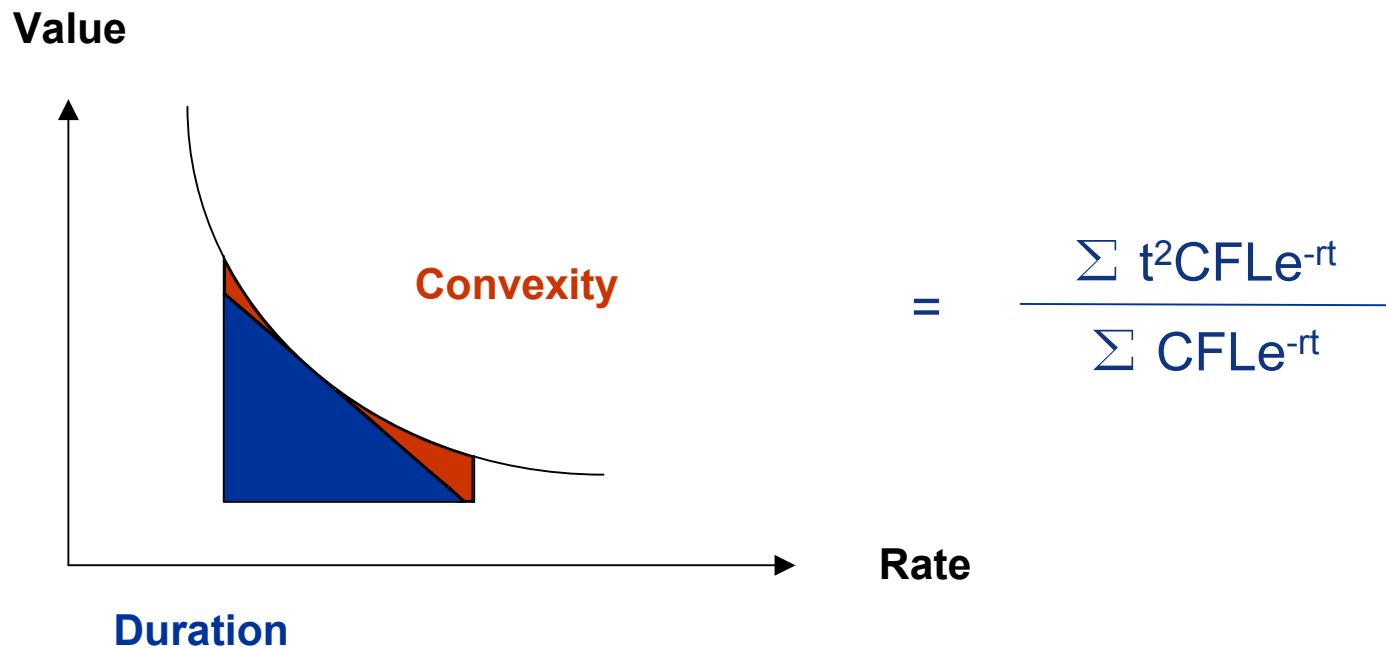
AS	LB
<p>NPV 1□□□ Dur 5</p>	<p>NVP 9□□</p>
	<p>EQ NPr 1□□ DUR = ?</p>

Let's assume rates go up 1%

NPV _{AS} :	1000	→	950 (-50)
NPV _{LB} :	900	→	882 (+18)
<u>Net</u>			<u>-32</u>

Ergo: We lose 32 on a net pos. of 100 → DUREQ = 32

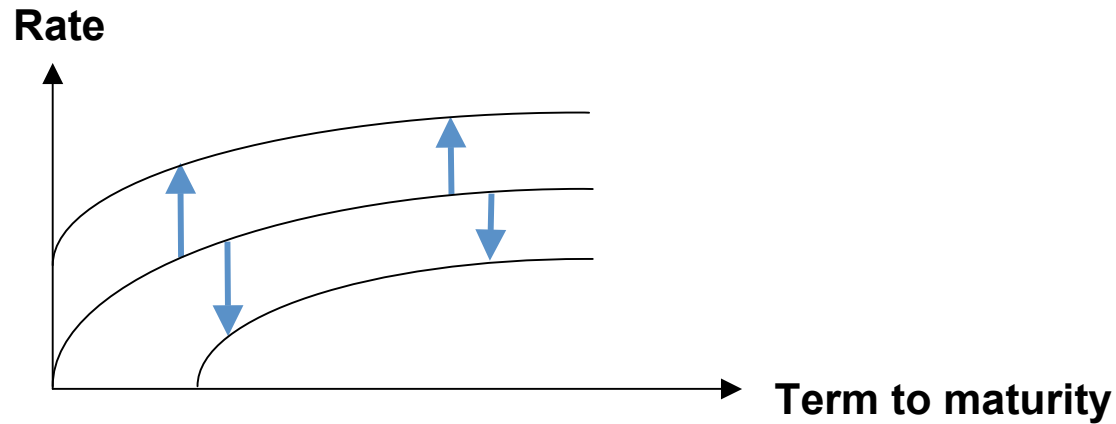
Duration is a linear approximation to a “curved” curve.
Convexity shows the first order deviation from linearity



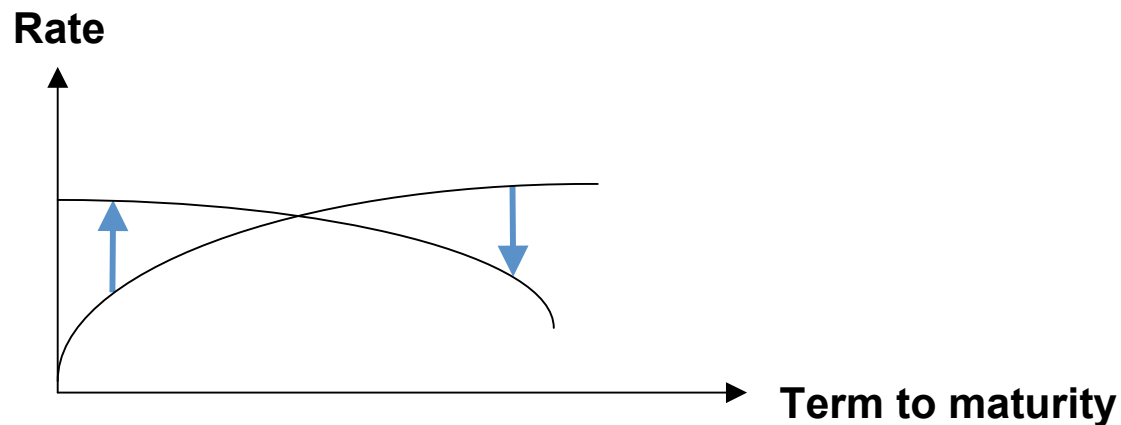
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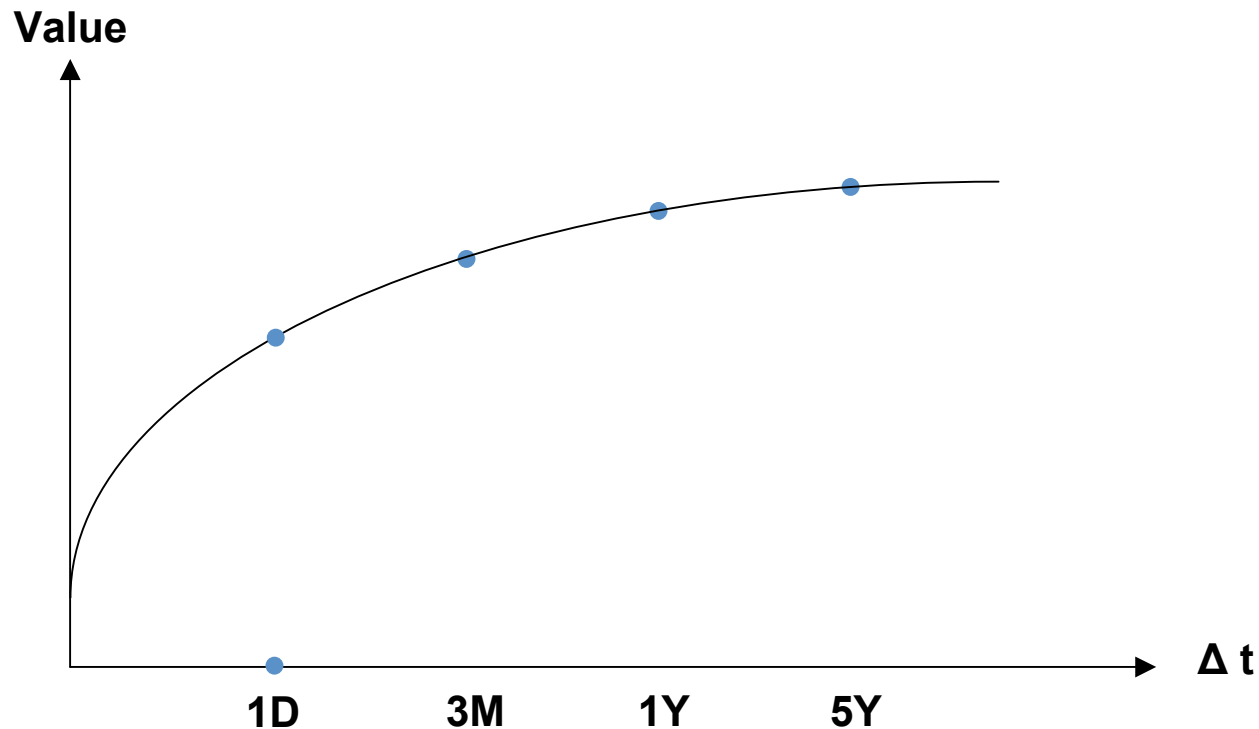
Duration measures only parallel shifts in yield curves:



But yield curves can shift like:

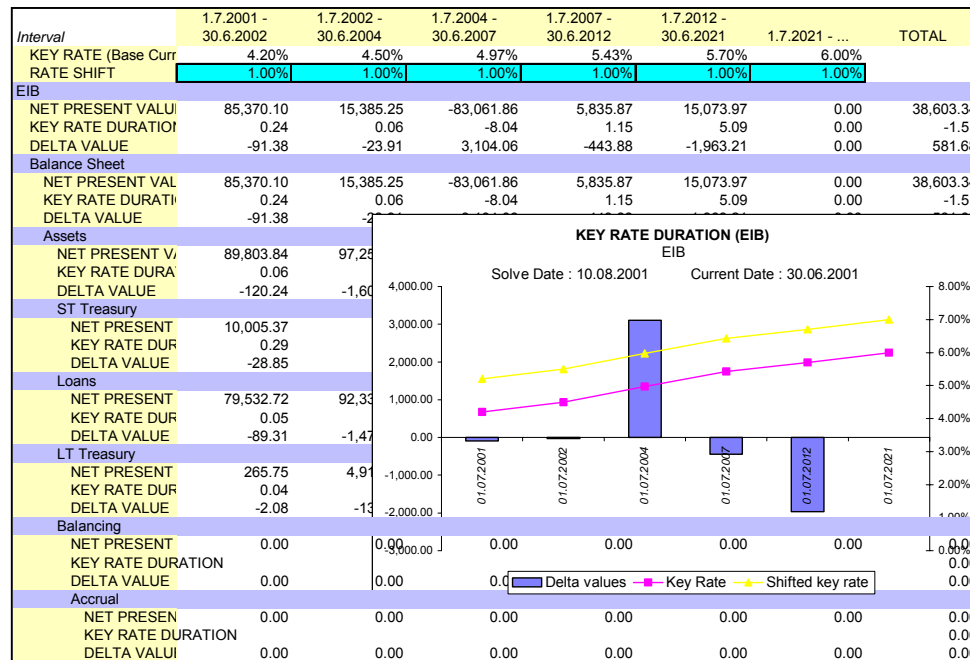


- Yield curve is split into key rates (important rates if they move)



- Cash flows are divided similarly

- We see the effect of each key rate on the corresponding segment of cash flows
- The parallel shift assumption can be dropped
- It is a mix between Gap and Duration Analysis
- A good tool for practical hedging



Duration, Convexity, and Related Measures

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4. VaR takes σ_r into account

- Gap and Duration measure only ΔT , Δr is taken only intuitively into account
- VaR takes σ_r explicitly into account
- VaR takes correlation between different key rates into account

Dur: assume a 1% interest rate shock

$$\Delta \text{ NPV} = \text{NPV} \cdot \text{Dur} \cdot \underbrace{\Delta r}_{1\%} = \$\text{DUR} \cdot \underbrace{\Delta r}_{1\%}$$

VaR: take the volatility (simple case, only 1 rate)

$$\sigma \text{ NPV} = \text{NPV} \cdot \text{Dur} \cdot \sigma_r = \$\text{DUR} \cdot \sigma_r$$

$$\sigma \text{ NPV} = \sqrt{\overrightarrow{\$DUR}' \cdot \Sigma \cdot \overrightarrow{\$DUR}}$$

$$\Sigma = \begin{matrix} & \sigma_{11}, \sigma_{12} \dots \sigma_{1n} \\ \sigma_{21}, \sigma_{22} & \cdot & \vdots \\ \vdots & & \ddots \\ \sigma_{m1} \dots \dots \dots \sigma_{mn} \end{matrix}$$

$$\overrightarrow{\$DUR} =$$

- \$DUR rate 1
- \$DUR rate 2
- ⋮
- \$DUR rate n
- FX Sens. 1
- FX Sens. 2
- ⋮
- FX Sens. n
- IDX Sens. 1
- IDX Sens. 2
- ⋮
- IDX Sens. n

= Sens. Vector

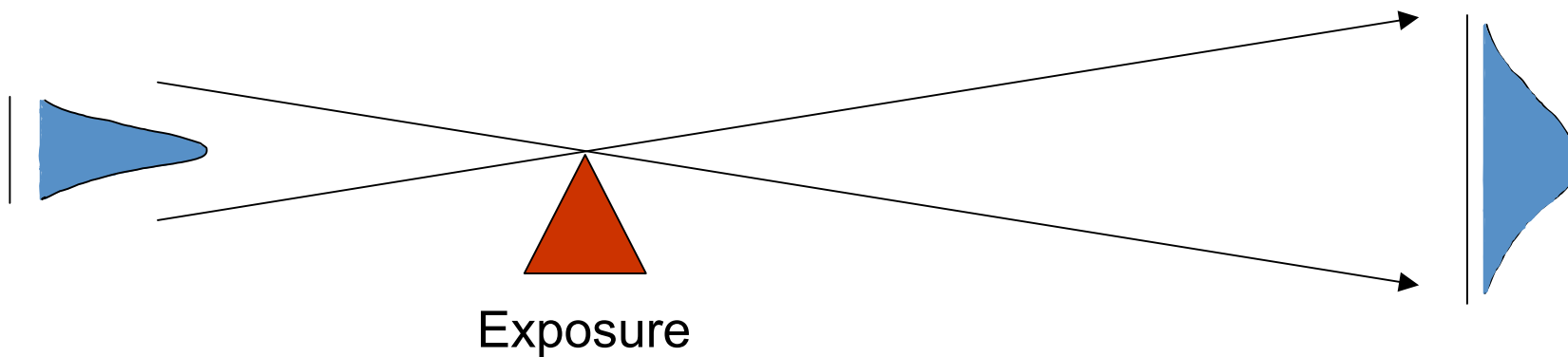
Interest Rate

Value



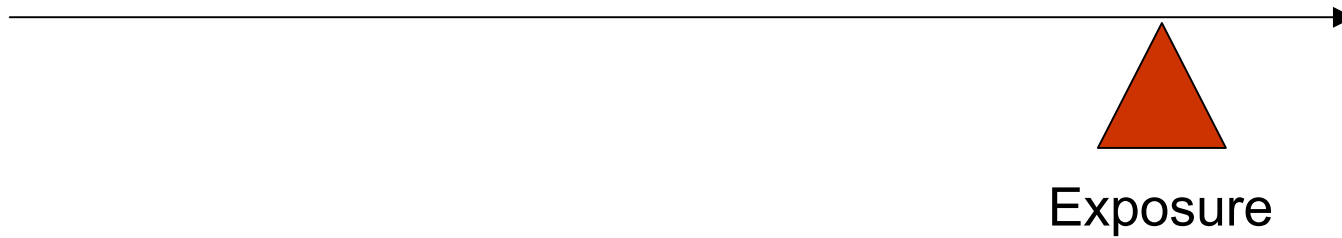
Interest Rate

Value



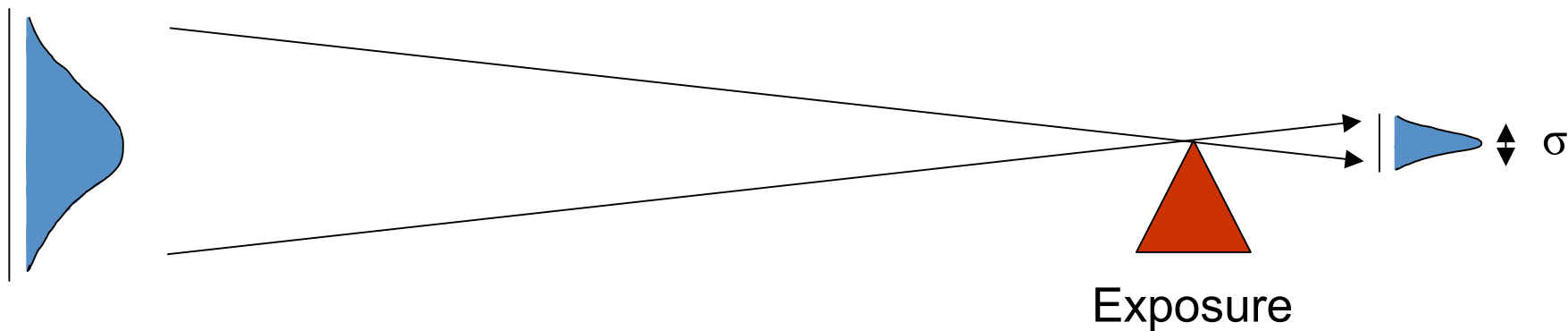
Interest Rate

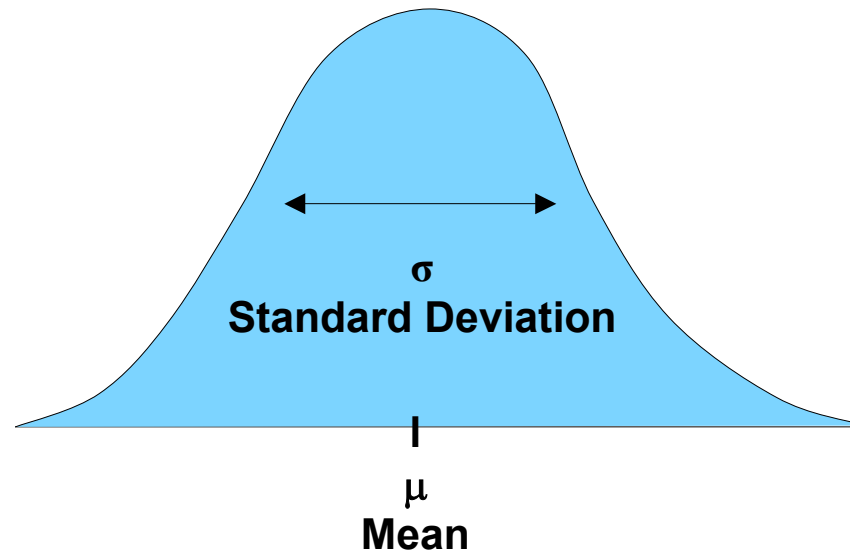
Value



Interest Rate

Value





- 1σ : 20% of all cases are worse than 1σ
- 1.65σ : 5% of all cases are worse than 1.65σ
- 2σ : 2.5% of all cases are worse than 2σ
- 3σ : 0.5% of all cases are worse than 3σ
- etc.

- Parametric
- Monte Carlo
- Historic

	EIB	Assets	Liabilities
NET PRESENT VALUE			
MEAN	38,603.34	212,375.82	-173,772.49
STD DEVIATION	396.37	662.24	911.24
SDT DEVIATION (Holding Period)	72.37	120.91	166.37
HOLDING PERIOD (Days)	1	1	1
CONFIDENCE LEVEL	95.00%	95.00%	95.00%
VALUE AT RISK	119.04	198.88	273.66
BOUNDARY VALUE	38,484.30	212,176.94	-174,046.15
VAR IN % OF NPV	0.31%	0.09%	-0.16%
LIMIT			
AMOUNT	396.37	662.24	911.24
BOUNDARY VALUE	38,206.97	211,713.58	-174,683.73
PROBABILITY	0.00%	0.00%	0.00%
CLAIMED AT CONF. INTERVAL	30.03%	30.03%	30.03%
RISK FACTOR DECOMPOSITION			
INTEREST RATE RISK	0.04	0.88	0.66
FX RISK			
STOCK MARKET RISK			
COMMODITY RISK			
DIVERSIFICATION EFFECT			
TOTAL RISK			
IDENTIFICATION			
Solve Date	8/10/2001		
SOLVE OPTIONS			
Valuation Spreads	No		
Matrix Name	M05022001		
Holding Period (days)	30		
REPORT OPTIONS			
Portfolio	Chart of account		

	EIB	Assets	Liabilities
NET PRESENT VALUE			
CURRENT	38,603.34	212,375.82	-173,772.49
MEAN	38,600.02	212,377.92	-173,777.90
STD DEVIATION	75.73	122.33	168.82
HOLDING PERIOD (Days)	1	1	1
CONFIDENCE LEVEL	95.00%	95.00%	
VALUE AT RISK	125.79	191.78	
BOUNDARY VALUE	38,474.23	212,186.14	
VAR IN % OF NPV	0.33%	0.09%	
LIMIT			
AMOUNT	75.73	122.33	
BOUNDARY VALUE	38,524.29	212,255.60	
PROBABILITY	0.00%	16.60%	
CLAIMED AT CONF. INTERVAL	166.10%	156.78%	
LEFT TAIL DATA			
MEAN	38,441.31	212,122.25	
STD DEVIATION	26.87	49.78	
MIN (Worst case)	38,328.71	211,930.31	
WORST CASE IN % OF NPV	99.30%	99.79%	
RISK FACTOR DECOMPOSITION			
INTEREST RATE RISK	125.79	191.78	
FX RISK	0.00	0.00	
STOCK MARKET RISK	0.00	0.00	
COMMODITY RISK	0.00	0.00	
DIVERSIFICATION EFFECT	0.00	0.00	0.00
TOTAL RISK	125.79	191.78	282.57

VaR (Monte Carlo)
EIB

Solve Date : 10.08.2001 Current Date : 30.06.2001

Legend: Confidence (blue), Out confidence (red), Frequency (green), Limit (yellow)

	EIB	Scenario	NPV	Scenario	NPV	Scenario	NPV	Scenario	NPV	Scenario	NPV
IDENTIFICATION		833	38,328.71	375	38,497.19	156	38,537.67	425	38,559.84	473	38,583.44
Current Date	6/30/2001	655	38,382.38	515	38,497.98	243	38,537.93	262	38,560.01	768	38,583.64
Solve Date	8/10/2001	984	38,385.00	90	38,498.45	855	38,538.27	740	38,560.31	359	38,583.85
Price Date	6/30/2001	431	38,399.83	439	38,499.21	713	38,538.51	61	38,560.49	567	38,583.89
SOLVE OPTIONS		543	38,402.90	26	38,499.53	727	38,538.75	391	38,560.67	343	38,584.20
Valuation Spreads	No	914	38,412.28	346	38,499.64	871	38,539.22	360	38,560.78	641	38,584.24
Matrix Name	M05022001	344	38,419.93	554	38,499.91	606	38,539.30	427	38,561.09	552	38,584.28
Holding Period (days)	1	16	38,421.26	769	38,500.58	783	38,539.93	206	38,561.12	960	38,584.72
REPORT OPTIONS		494	38,424.64	621	38,500.90	812	38,539.93	316	38,561.15	637	38,584.99
Portfolio	Chart of accoun	390	38,427.32	306	38,501.25	338	38,540.17	157	38,561.20	840	38,585.46
		789	38,428.30	46	38,502.68	967	38,540.32	491	38,561.23	754	38,585.48

