

# Introduction to Insurers risk management

## 1BP461



EVROPSKÁ UNIE  
Evropské strukturální a investiční fondy  
Operační program Výzkum, vývoj a vzdělávání



References: DOFF, Rene. Risk Management for Insurers. 2. London: Incisive Media Investments, 2011. ISBN 978 1 906348 61 8.

# Insurance balance sheet

## Investments

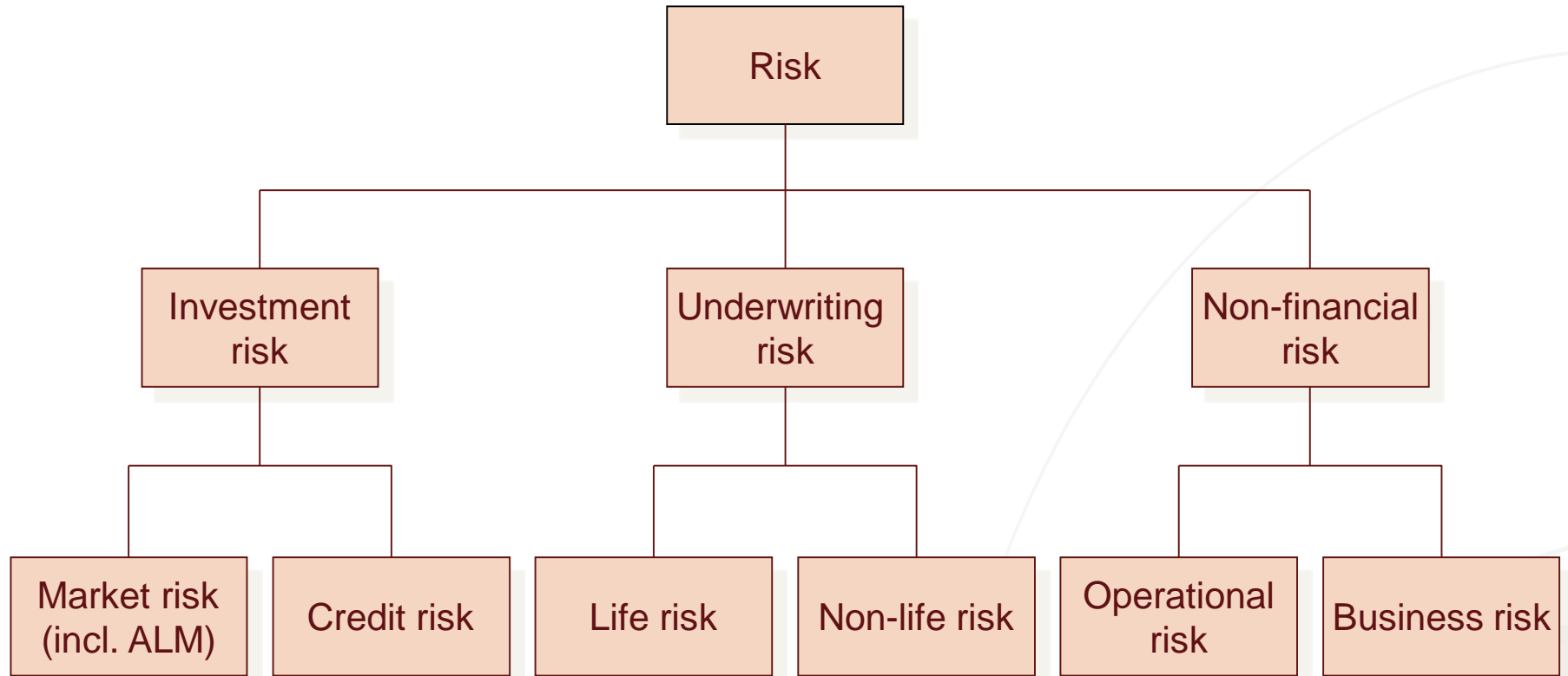
(government)  
Bonds, stocks,  
other investments

Equity  
capital

Technical  
Provisions

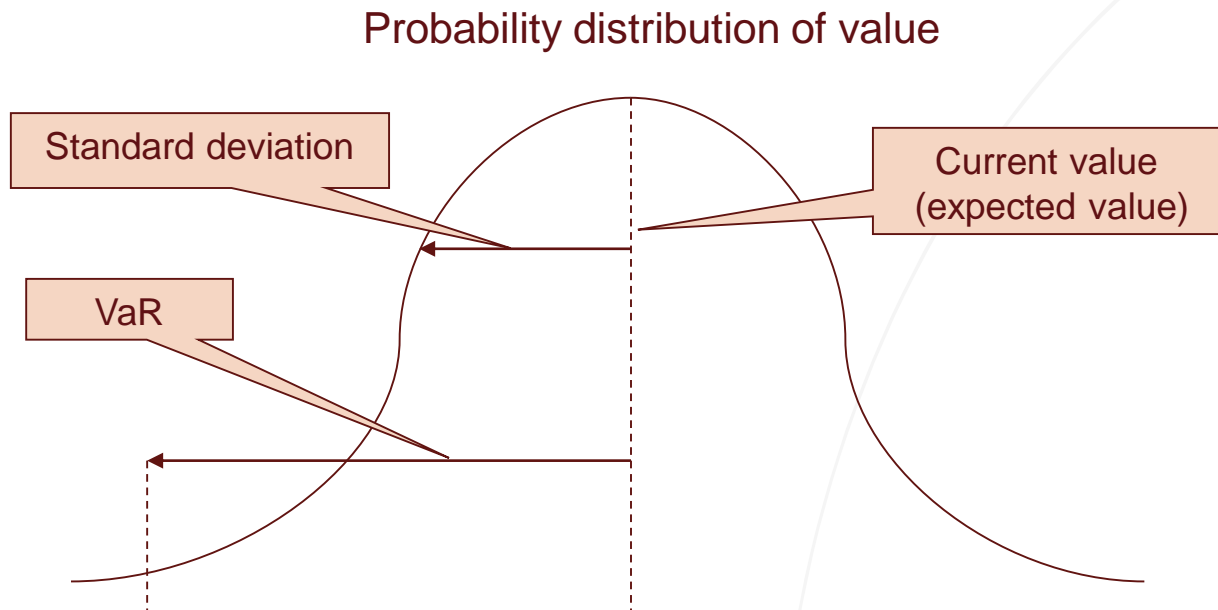
(including  
implicit  
prudence)

# Risk categories



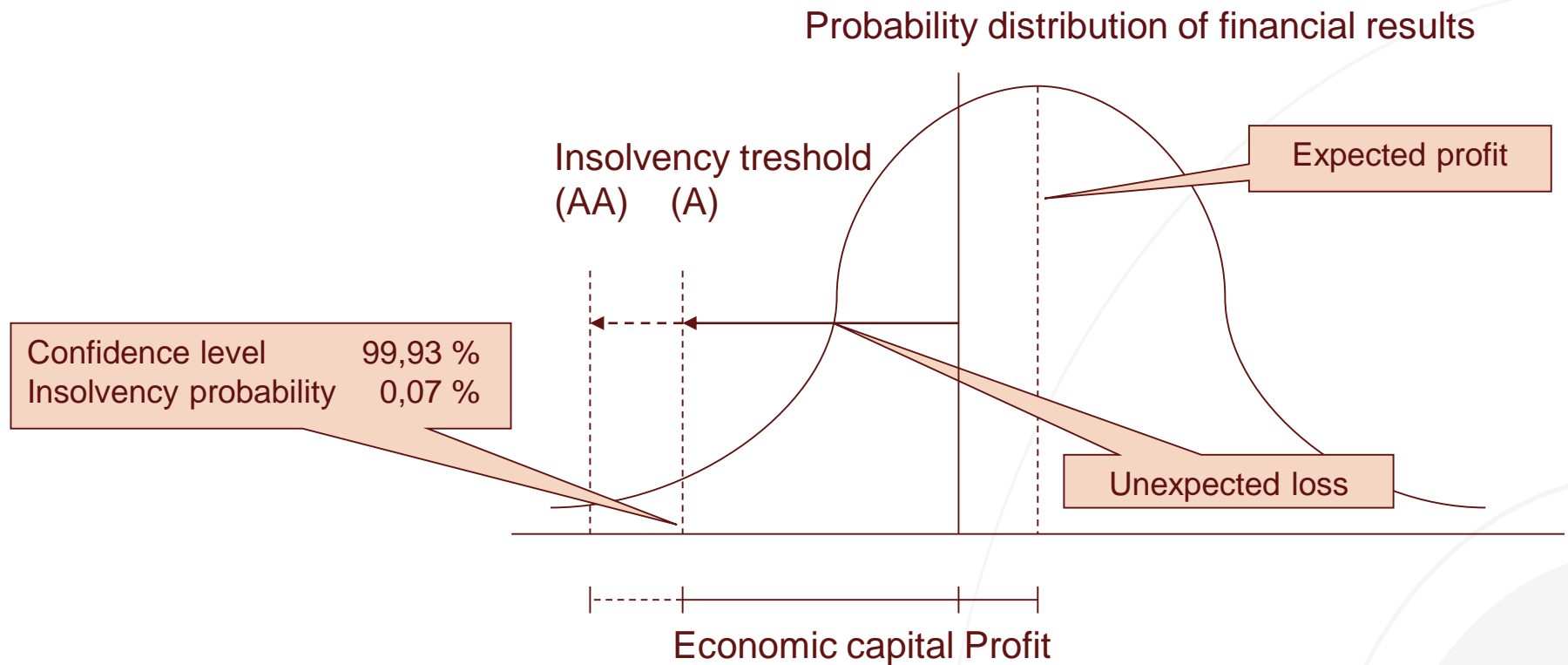
Source: Author

# VaR as a multiple of standard deviation



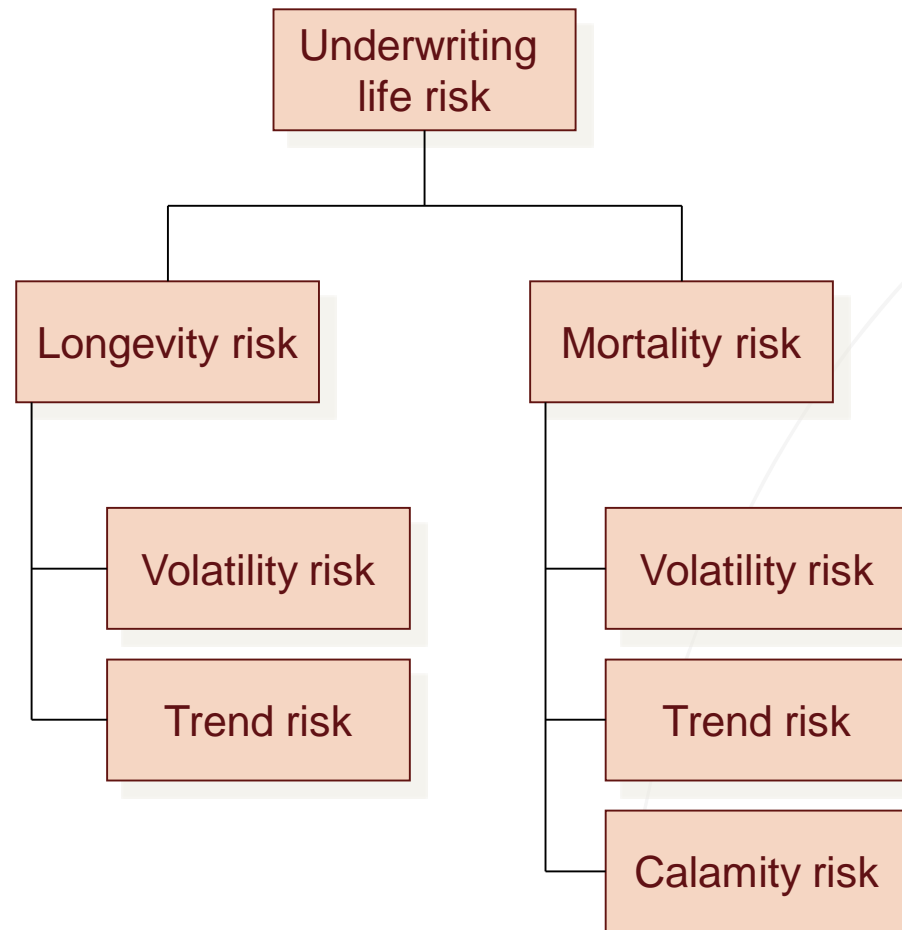
Source: Author

# Economic capital rating ambition



Source: Author

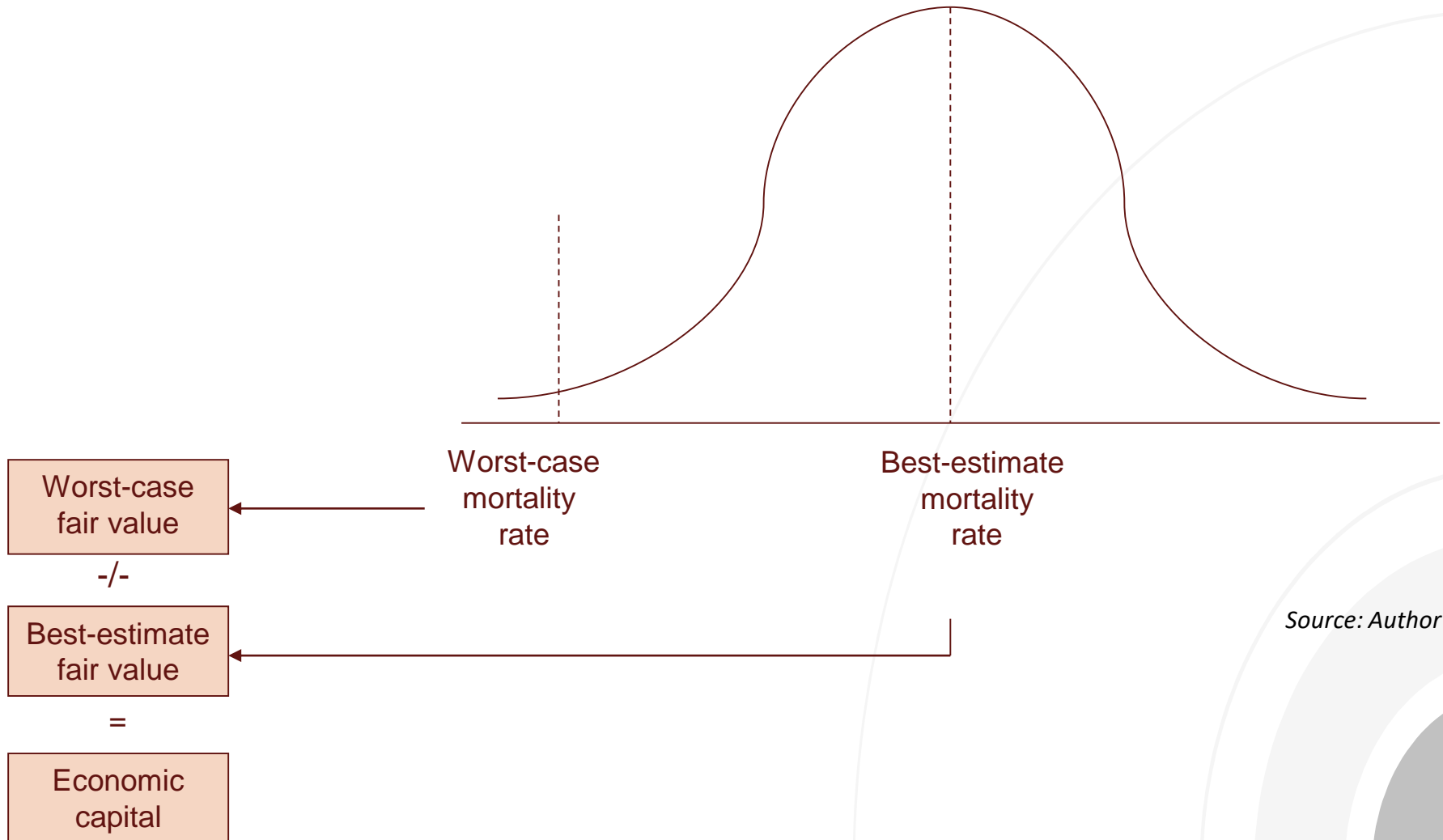
# Components of life underwriting risk



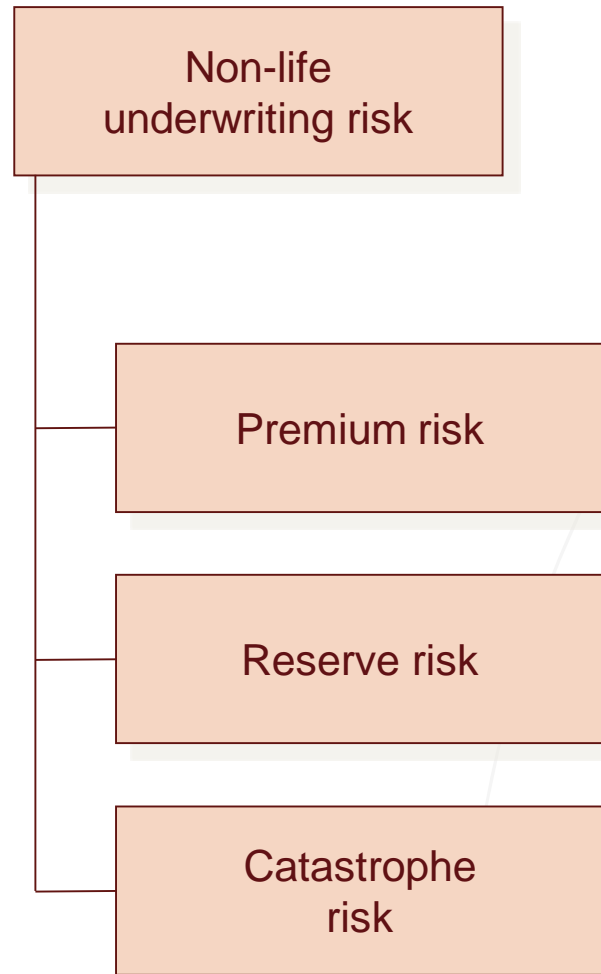
Source: Author

# Economic capital for life risk

Probability distribution of mortality rate



# Components of non-life underwriting risk



*Source: Author*



# Economic capital for reserve risk

		Development year				
		1	2	3	4	5
Accident year	2002	€ 100	€ 50	€ 30	€ 10	€ 5
	2003	€ 103	€ 51	€ 31	€ 10	€ 6
	2004	€ 106	€ 53	€ 32	€ 14	€ 6
	2005	€ 73	€ 37	€ 28	€ 9	€ 5
	2006	€ 149	€ 93	€ 56	€ 19	€ 9
	2007	€ 193	€ 96	€ 58	€ 19	€ 10

Worst-case (99,95 %) run-off pattern



Worst-case  
fair value

-/-

		Development year				
		1	2	3	4	5
Accident year	2002	€ 100	€ 50	€ 30	€ 10	€ 5
	2003	€ 103	€ 51	€ 31	€ 10	€ 5
	2004	€ 106	€ 53	€ 32	€ 11	€ 5
	2005	€ 73	€ 37	€ 22	€ 7	€ 4
	2006	€ 149	€ 74	€ 45	€ 15	€ 7
	2007	€ 154	€ 77	€ 46	€ 15	€ 8

Best-estimate (expected) run-off pattern

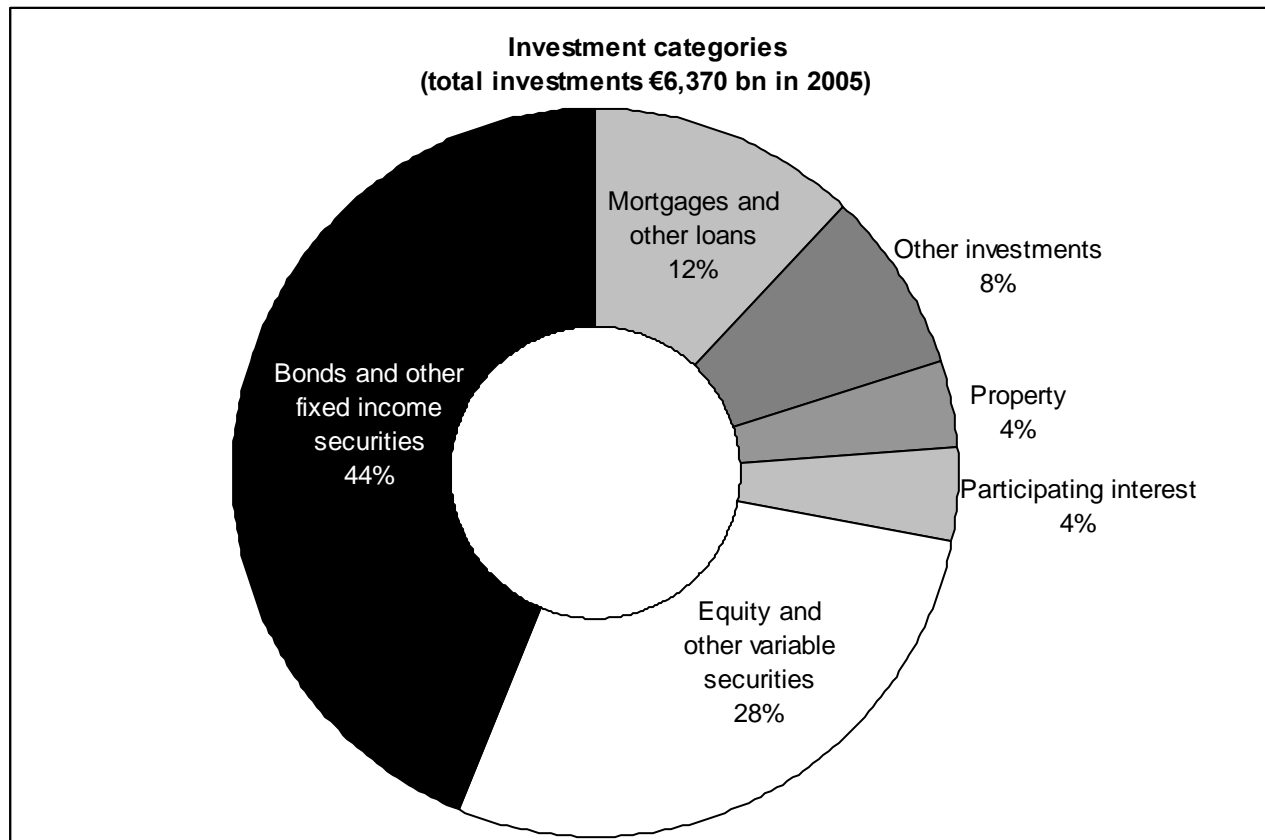


Best-estimate  
fair value

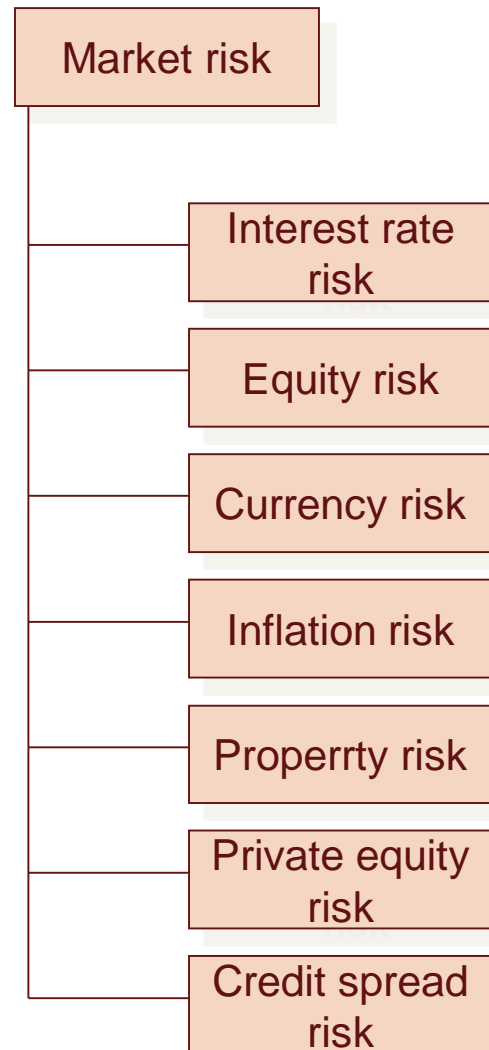
=

Economic  
capital

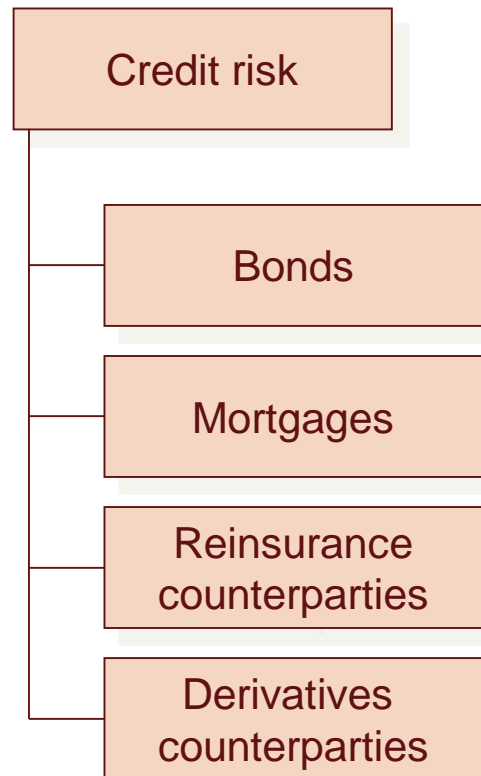
# Total investment portfolio of European insurers



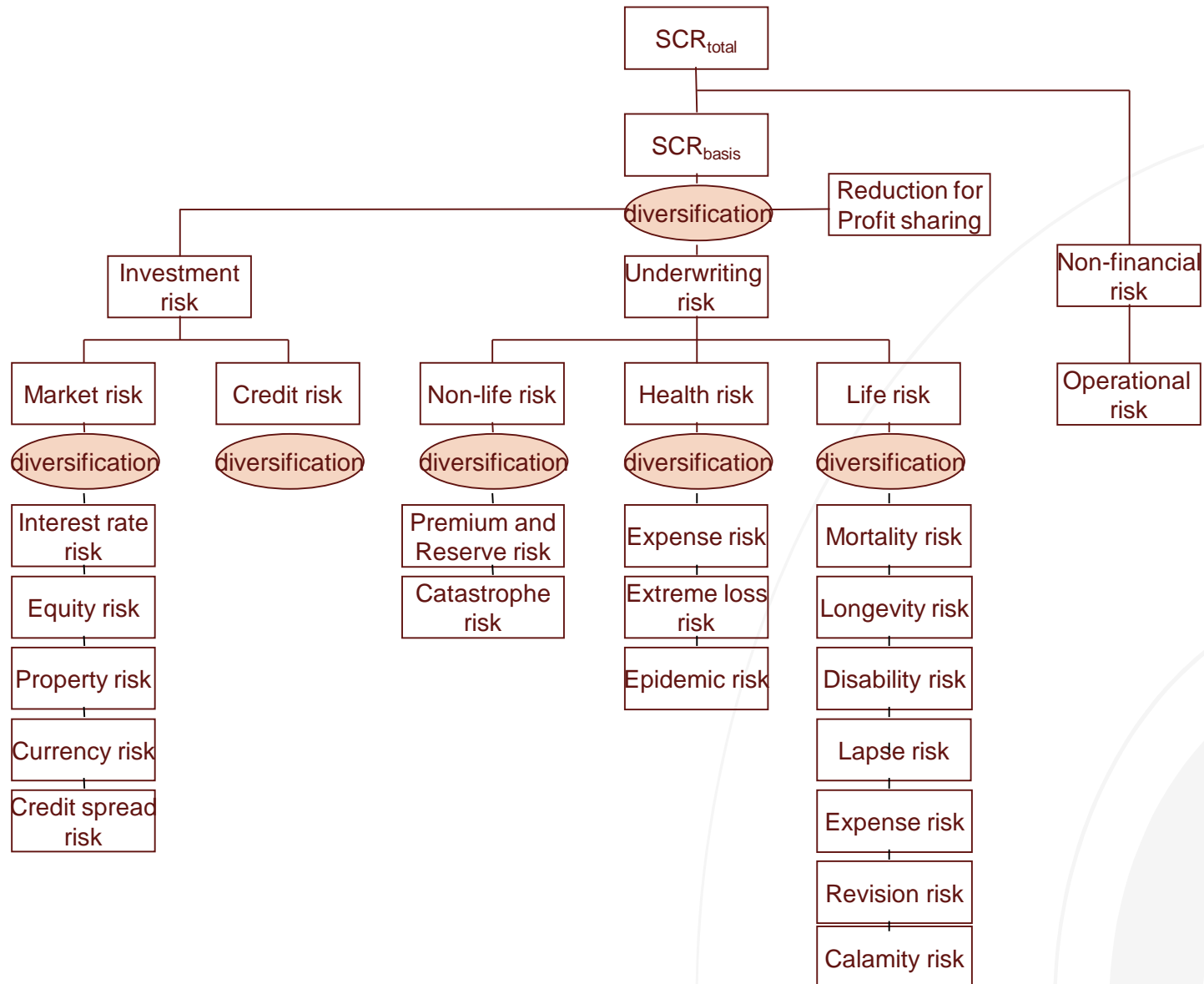
# Components of market risk



# Components of credit risk



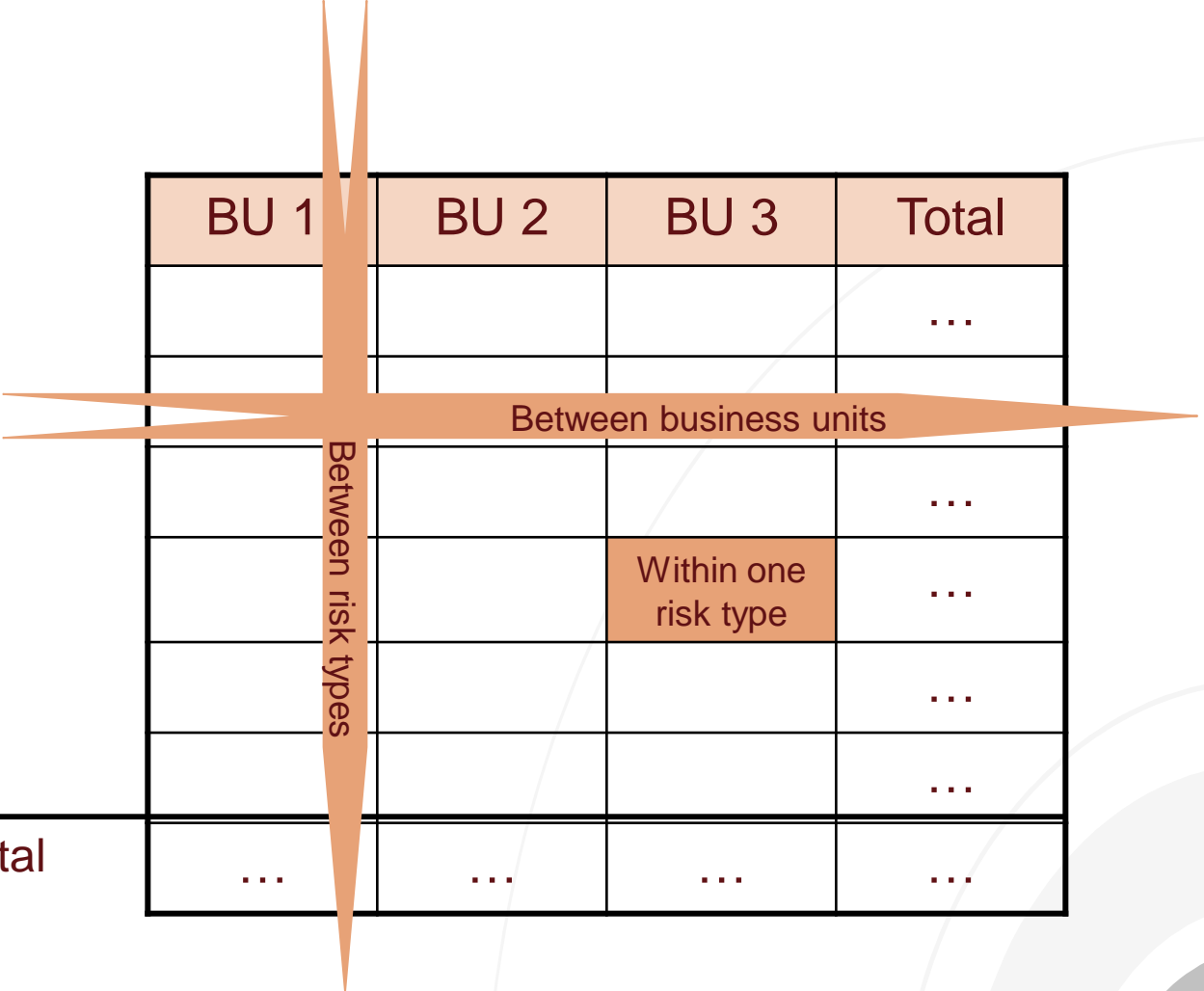
# Modular standardised approach to the SCR



# Calculation methods for each of the SCR modules in QIS3

Risk type	Component	Methodology for SCR
Market risk	Interest rate risk	Maximum of upward and downward interest rate shocks (non-parallel)
	Equity risk	32% decrease for global stock markets and 45% for other markets
	Property risk	20% decrease in property markets
	Currency risk	20% change in foreign exchange rates
	Credit spread risk	Market value of the bond times duration times a factor, depending on rating of the bond
	Concentration	An additional charge for investments with exposures above specified thresholds
	Aggregation	Correlation matrix and taking into account reductions for profit sharing
Credit risk		Replacement costs of a certain credit exposure times a function based on PD per exposure (consistent with Basel II)
Non-life risk	Premium and reserve risk	Premiums or reserves times function of standard deviation
	CAT risk	Sum of losses of series of specified CAT scenarios
	Aggregation	Correlation matrix
Health risk	Expense risk	Factor times standard deviation of expenses (10 year historical data) times gross premium
	Claim risk	Factor times standard deviation of health results (10 year historical data) times gross premium
	Epidemic risk	Factor times gross premium times market share
	Aggregation	Correlation matrix and taking into account reductions for profit sharing
Life risk	Mortality risk	10% increase in mortality rates in each age class
	Longevity risk	25% decrease in mortality rates in each age class
	Disability	35% increase in disability rates for next year, combined with 25% permanent increase
	Lapse risk	50% increase in lapse rates on permanent annual increase of 3% of lapse rates
	Expense risk	10% increase in expenses and 1% increase in permanent expense inflation rate
	Revision risk	3% increase in annuity benefits for relevant products
	Calamity risk	A factor for increased mortality rates and for increased lapse rates in case of a CAT event
	Aggregation	Correlation matrix and taking into account reductions for profit sharing
Operational risk		Factor times earnings or technical provisions, depending on business line

# Three kinds of diversification



	BU 1	BU 2	BU 3	Total
Life risk				...
Non-life risk				...
Market risk				...
Credit risk			Within one risk type	...
Operational risk				...
Business risk				...
Total	...	...	...	...

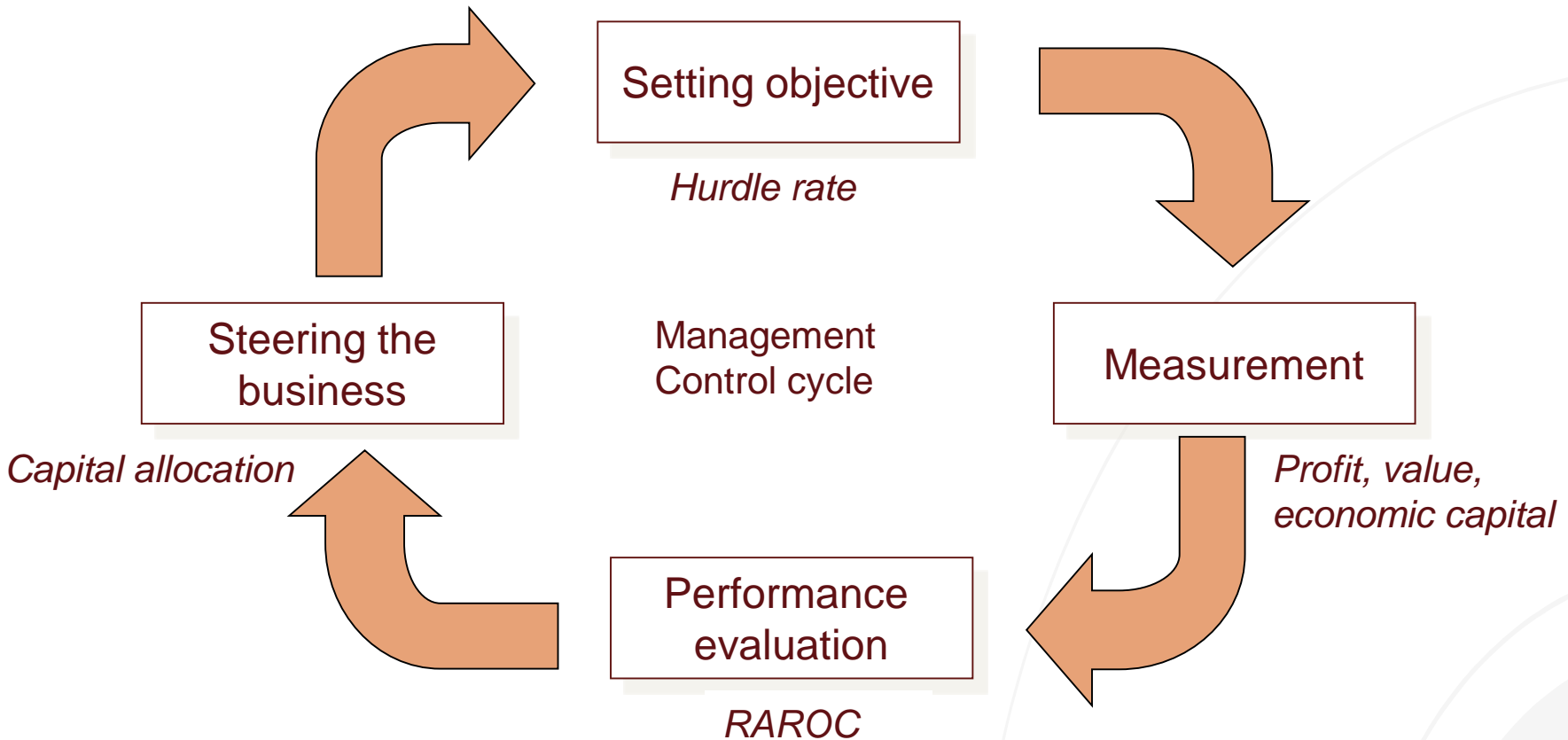
Between risk types

Between business units

Within one risk type

Source: Author

# Management control cycle and economic capital



Source: Author



# Introduction to ALM

References: HULL, John. Risk management and financial institutions. 5. London: John Wiley & Sons, 2008. ISBN 0-13-613427-0

# Today

- An introduction to the asset/liability management (ALM) process
  - What is the goal of ALM?
- The concepts of duration and convexity
  - Extremely important for insurance enterprises
- Extensions to duration
  - Partial duration or key rate duration

# Asset/Liability Management

- As its name suggests, ALM involves the process of analyzing the interaction of assets and liabilities
- In its broadest meaning, ALM refers to the process of maximizing risk-adjusted return
- Risk refers to the variance (or standard deviation) of earnings
- More risk in the surplus position (assets minus liabilities) requires extra capital for protection of policyholders

# The ALM Process

- Firms forecast earnings and surplus based on “best estimate” or “most probable” assumptions with respect to:
  - Sales or market share
  - The future level of interest rates or the business activity
  - Lapse rates
  - Loss development
- ALM tests the sensitivity of results for changes in these variables

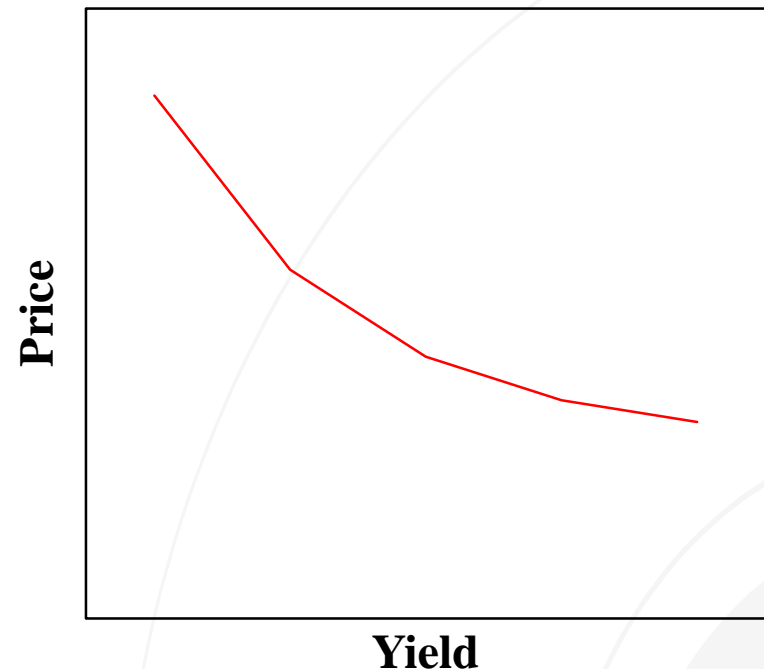
# The Goal of ALM

- If assets can be purchased to replicate the liabilities in every potential future state of nature, there would be no risk
- The goal of ALM is to analyze how assets and liabilities move to changes in interest rates and other variables
- We will need tools to quantify the risk in the assets AND liabilities

# Price/Yield Relationship

- Recall that bond prices move inversely with interest rates
  - As interest rates increase, present value of fixed cash flows decrease
- For option-free bonds, this curve is not linear but *convex*

**Price/yield curve**



Source: Author

# Simplifications

- Fixed income, non-callable bonds
- Flat yield curve
- Parallel shifts in the yield curve

# Examining Interest Rate Sensitivity

- Start with two \$1000 face value zero coupon bonds
- One 5 year bond and one 10 year bond
- Assume current interest rates are 8%



## Price Changes on Two Zero Coupon Bonds

Initial Interest Rate = 8%

<b>Principal</b>	<b>R</b>	<b>5 year</b>	<b>Change</b>	<b>10 year</b>	<b>Change</b>
1000	0.06	747.2582	9.7967%	558.3948	20.5532%
1000	0.07	712.9862	4.7611%	508.3493	9.7488%
1000	0.0799	680.8984	0.0463%	463.6226	0.0926%
1000	0.08	680.5832	0.0000%	463.1935	0.0000%
1000	0.0801	680.2682	-0.0463%	462.7648	-0.0925%
1000	0.09	649.9314	-4.5038%	422.4108	-8.8047%
1000	0.1	620.9213	-8.7663%	385.5433	-16.7641%

Source: Author

# Price Volatility Characteristics of Option-Free Bonds

## Properties

- 1 All prices move in opposite direction of change in yield, but the change differs by bond
- 2+3 The percentage price change is not the same for increases and decreases in yields
- 4 Percentage price increases are greater than decreases for a given change in basis points

## Characteristics

- 1 For a given term to maturity and initial yield, the lower the coupon rate the greater the price volatility
- 2 For a given coupon rate and initial yield, the longer the term to maturity, the greater the price volatility

# Macaulay Duration

- Developed in 1938 to measure price sensitivity of bonds to interest rate changes
- Macaulay used the weighted average term-to-maturity as a measure of interest sensitivity
- As we will see, this is related to interest rate sensitivity

## Macauley Duration (p.2)

$$\text{Macauley Duration} = \sum_{t=1}^n \frac{t \times PVCF_t}{k \times PVTCF_t}$$

$t$  = index for period

$n$  = total number of period

$k$  = number of coupon payments per year

$PVCF_t$  = Present value of cash flow in period  $t$

$PVTCF_t$  = Total present value of cash flows (price)

# Applying Macaulay Duration

- For a zero coupon bond, the Macaulay duration is equal to maturity
- For coupon bonds, the duration is less than its maturity
- For two bonds with the same maturity, the bond with the lower coupon has higher duration

Percentage change in price =

$$-\frac{1}{1 + \frac{yield}{k}} \times \text{Macaulay duration} \times \text{Yield change} \times 100$$

## Modified Duration

- Another measure of price sensitivity is determined by the slope of the price/yield curve
- When we divide the slope by the current price, we get a duration measure called modified duration
- The formula for the predicted price change of a bond using Macaulay duration is based on the first derivative of price with respect to yield (or interest rate)

# Modified Duration and Macaulay Duration

$$P = \sum \frac{CF_t}{(1+i)^t}$$

$$\text{Modified duration} = -\frac{\partial P}{\partial i} \times \frac{1}{P} = \sum \frac{t \times CF_t}{(1+i)^{t+1}} \times \frac{1}{P}$$

$$= \frac{1}{(1+i)} \times \text{Macaulay duration}$$

$i$  = yield

$P$  = price

CF = Cash flow

# An Example

Calculate:

What is the modified duration of a 3-year, 3% bond if interest rates are 5%?



## Solution to Example

<i><b>Period</b></i>	<i><b>Cash Flow</b></i>	<i><b>PV</b></i>	<i><b>t x PV</b></i>
1	3	2.86	2.86
2	3	2.72	5.44
3	103	88.98	266.93
<i><b>Total</b></i>		<i><b>94.55</b></i>	<i><b>275.23</b></i>

$$\text{Macaulay duration} = \frac{275.23}{94.55} = 2.91$$

$$\text{Modified duration} = \frac{2.91}{1.05} = 2.77$$

## Example Continued

- What is the predicted price change of the 3 year, 3% coupon bond if interest rates increase to 6%?

## Example Continued

- What is the predicted price change of the 3 year, 3% coupon bond if interest rates increase to 6%?

$$\begin{aligned}\% \text{ Price Change} &= -\text{Modified Duration} \times \text{Yield Change} \\ &= -2.77 \times .01 = -2.77\%\end{aligned}$$

## Other Interest Rate Sensitivity Measures

- Instead of expressing duration in percentage terms, dollar duration gives the absolute dollar change in bond value
  - Multiply the modified duration by the yield change and the initial price
- Present Value of a Basis Point (PVBP) is the dollar duration of a bond for a one basis point movement in the interest rate
  - This is also known as the dollar value of an 01 (DV01)

# A Different Methodology

- The “Valuation...” book does not use the formulae shown here
- Instead, duration can be computed numerically
  - Calculate the price change given an increase in interest rates of  $i$
  - Numerically calculate the derivative using actual bond prices:

$$\text{Duration} = - \frac{\Delta P}{\Delta i} / P$$

# Introduction to VaR

References: HULL, John. Risk management and financial institutions. 5. London: John Wiley & Sons, 2008. ISBN 0-13-613427-0

# The Question Being Asked in VaR

“What loss level is such that we are  $X\%$  confident it will not be exceeded in  $N$  business days?”

# VaR and Regulatory Capital

- Regulators base the capital they require banks to keep on VaR
- The market-risk capital is  $k$  times the 10-day 99% VaR where  $k$  is at least 3.0



## VaR vs. C-VaR

- VaR is the loss level that will not be exceeded with a specified probability
- C-VaR (or expected shortfall) is the expected loss given that the loss is greater than the VaR level
- Although C-VaR is theoretically more appealing, it is not widely used

# Advantages of VaR

- It captures an important aspect of risk in a single number
- It is easy to understand
- It asks the simple question: “How bad can things get?”

# Time Horizon

- Instead of calculating the 10-day, 99% VaR directly analysts usually calculate a 1-day 99% VaR and assume

$$10\text{-day VaR} = \sqrt{10} \times 1\text{-day VaR}$$

- This is exactly true when portfolio changes on successive days come from independent identically distributed normal distributions

# Historical Simulation

- Create a database of the daily movements in all market variables.
- The first simulation trial assumes that the percentage changes in all market variables are as on the first day
- The second simulation trial assumes that the percentage changes in all market variables are as on the second day
- and so on

## Historical Simulation continued

- Suppose we use  $m$  days of historical data
- Let  $v_i$  be the value of a variable on day  $i$
- There are  $m-1$  simulation trials
- The  $i$ th trial assumes that the value of the market variable tomorrow (i.e., on day  $m+1$ ) is

$$v_m \frac{v_i}{v_{i-1}}$$

# The Model-Building Approach

- The main alternative to historical simulation is to make assumptions about the probability distributions of return on the market variables and calculate the probability distribution of the change in the value of the portfolio analytically
- This is known as the model building approach or the variance-covariance approach

# Daily Volatilities

- In option pricing we measure volatility “per year”
- In VaR calculations we measure volatility “per day”

$$\sigma_{\text{day}} = \frac{\sigma_{\text{year}}}{\sqrt{252}}$$

## Daily Volatility continued

- Strictly speaking we should define  $\sigma_{\text{day}}$  as the standard deviation of the continuously compounded return in one day
- In practice we assume that it is the standard deviation of the percentage change in one day



# Microsoft Example

- We have a position worth \$10 million in Microsoft shares
- The volatility of Microsoft is 2% per day (about 32% per year)
- We use  $N=10$  and  $X=99$

## Microsoft Example continued

- The standard deviation of the change in the portfolio in 1 day is \$200,000
- The standard deviation of the change in 10 days is

$$200,000\sqrt{10} = \$632,456$$

## Microsoft Example continued

- We assume that the expected change in the value of the portfolio is zero (This is OK for short time periods)
- We assume that the change in the value of the portfolio is normally distributed
- Since  $N(-2.33)=0.01$ , the VaR is

$$2.33 \times 632,456 = \$1,473,621$$

# AT&T Example

- Consider a position of \$5 million in AT&T
- The daily volatility of AT&T is 1% (approx 16% per year)
- The S.D per 10 days is
- The VaR is

$$50,000\sqrt{10} = \$158,144$$

$$158,114 \times 2.33 = \$368,405$$

# Portfolio

- Now consider a portfolio consisting of both Microsoft and AT&T
- Suppose that the correlation between the returns is 0.3

# S.D. of Portfolio

- A standard result in statistics states that
- In this case  $\sigma_X = 200,000$  and  $\sigma_Y = 50,000$  and  $\rho = 0.3$ . The standard deviation of the change in the portfolio value in one day is therefore 220,227

$$\sigma_{X+Y} = \sqrt{\sigma_X^2 + \sigma_Y^2 + 2\rho\sigma_X\sigma_Y}$$

# VaR for Portfolio

- The 10-day 99% VaR for the portfolio is
- The benefits of diversification are  
 $(1,473,621 + 368,405) - 1,622,657 = \$219,369$
- What is the incremental effect of the AT&T holding on VaR?

$$220,227 \times \sqrt{10} \times 2.33 = \$1,622,657$$

# The Linear Model

We assume

- The daily change in the value of a portfolio is linearly related to the daily returns from market variables
- The returns from the market variables are normally distributed



## The General Linear Model continued

$$\Delta P = \sum_{i=1}^n \alpha_i \Delta x_i$$

$$\sigma_P^2 = \sum_{i=1}^n \sum_{j=1}^n \alpha_i \alpha_j \sigma_i \sigma_j \rho_{ij}$$

$$\sigma_P^2 = \sum_{i=1}^n \alpha_i^2 \sigma_i^2 + 2 \sum_{i < j} \alpha_i \alpha_j \sigma_i \sigma_j \rho_{ij}$$

where  $\sigma_i$  is the volatility of variable  $i$

and  $\sigma_P$  is the portfolio's standard deviation

# Handling Interest Rates: Cash Flow Mapping

- We choose as market variables bond prices with standard maturities (1mth, 3mth, 6mth, 1yr, 2yr, 5yr, 7yr, 10yr, 30yr)
- Suppose that the 5yr rate is 6% and the 7yr rate is 7% and we will receive a cash flow of \$10,000 in 6.5 years.
- The volatilities per day of the 5yr and 7yr bonds are 0.50% and 0.58% respectively

## Example continued

- We interpolate between the 5yr rate of 6% and the 7yr rate of 7% to get a 6.5yr rate of 6.75%
- The PV of the \$10,000 cash flow is

$$\frac{10,000}{1.0675^{6.5}} = 6,540$$

## Example continued

- We interpolate between the 0.5% volatility for the 5yr bond price and the 0.58% volatility for the 7yr bond price to get 0.56% as the volatility for the 6.5yr bond
- We allocate  $\alpha$  of the PV to the 5yr bond and  $(1 - \alpha)$  of the PV to the 7yr bond

## Example continued

- Suppose that the correlation between movement in the 5yr and 7yr bond prices is 0.6
- To match variances
- This gives  $\alpha=0.074$

$$0.56^2 = 0.5^2 \alpha^2 + 0.58^2 (1-\alpha)^2 + 2 \times 0.6 \times 0.5 \times 0.58 \times \alpha(1-\alpha)$$

# Example continued

The value of 6,540 received in 6.5 years

in 5 years and by

$$6,540 \times 0.074 = \$484$$

in 7 years.  $6,540 \times 0.926 = \$6,056$

This cash flow mapping preserves value and variance

# When Linear Model Can be Used

- Portfolio of stocks
- Portfolio of bonds
- Forward contract on foreign currency
- Interest-rate swap

# The Linear Model and Options

Consider a portfolio of options dependent on a single stock price,  $S$ . Define

and 
$$\delta = \frac{\Delta P}{\Delta S}$$

$$\Delta x = \frac{\Delta S}{S}$$



# Linear Model and Options continued

- As an approximation
- Similarly when there are many underlying market variables

$$\Delta P = \delta \Delta S = S \delta \Delta x$$

where  $\delta_i$  is the delta of the portfolio with respect to the  $i$ th asset

$$\Delta P = \sum_i S_i \delta_i \Delta x_i$$

# Example


- Consider an investment in options on Microsoft and AT&T. Suppose the stock prices are 120 and 30 respectively and the deltas of the portfolio with respect to the two stock prices are 1,000 and 20,000 respectively
- As an approximation

$$\Delta P = 120 \times 1,000 \Delta x_1 + 30 \times 20,000 \Delta x_2$$

where  $\Delta x_1$  and  $\Delta x_2$  are the percentage changes in the two stock prices

# Skewness

The linear model fails to capture skewness in the probability distribution of the portfolio value.

A decorative graphic in the bottom right corner consisting of several concentric, semi-circular arcs in shades of gray, creating a sense of depth and movement.

# Quadratic Model

For a portfolio dependent on a single stock price it is approximately true that this becomes

$$\Delta P = \delta \Delta S + \frac{1}{2} \gamma (\Delta S)^2$$

$$\Delta P = S \delta \Delta x + \frac{1}{2} S^2 \gamma (\Delta x)^2$$

## Quadratic Model continued

With many market variables we get an expression of the form

$$\Delta P = \sum_{i=1}^n S_i \delta_i \Delta x_i + \sum_{i=1}^n \frac{1}{2} S_i S_j \gamma_{ij} \Delta x_i \Delta x_j$$

where

$$\delta_i = \frac{\partial P}{\partial S_i} \quad \gamma_{ij} = \frac{\partial^2 P}{\partial S_i \partial S_j}$$

This is not as easy to work with as the linear model

# Monte Carlo Simulation

To calculate VaR using M.C. simulation we

- Value portfolio today
- Sample once from the multivariate distributions of the  $\Delta x_i$
- Use the  $\Delta x_i$  to determine market variables at end of one day
- Revalue the portfolio at the end of day

# Monte Carlo Simulation

- Calculate  $\Delta P$
- Repeat many times to build up a probability distribution for  $\Delta P$
- VaR is the appropriate fractile of the distribution times square root of  $N$
- For example, with 1,000 trial the 1 percentile is the 10th worst case.

# Speeding Up Monte Carlo

Use the quadratic approximation to calculate  $\Delta P$



# Comparison of Approaches

- Model building approach assumes normal distributions for market variables. It tends to give poor results for low delta portfolios
- Historical simulation lets historical data determine distributions, but is computationally slower

# Stress Testing

- This involves testing how well a portfolio performs under some of the most extreme market moves seen in the last 10 to 20 years

# Back-Testing

- Tests how well VaR estimates would have performed in the past
- We could ask the question: How often was the actual 10-day loss greater than the 99%/10 day VaR?

# Principal Components Analysis for Interest Rates

- The first factor is a roughly parallel shift (83.1% of variation explained)
- The second factor is a twist (10% of variation explained)
- The third factor is a bowing (2.8% of variation explained)

# Using PCA to calculate VaR

Example: Sensitivity of portfolio to rates (\$m)

1 yr	2 yr	3 yr	4 yr	5 yr
+10	+4	-8	-7	+2

*Source: Author*

Sensitivity to first factor :

$$10 \times 0.32 + 4 \times 0.35 - 8 \times 0.36 - 7 \times 0.36 + 2 \times 0.36 = -0.08$$

Similarly sensitivity to second factor =  $-4.40$

## Using PCA to calculate VaR continued

- As an approximation
- The  $f_1$  and  $f_2$  are independent
- The standard deviation of  $\Delta P$  is

$$\Delta P = -0.08f_1 - 4.40f_2$$

$$\sqrt{0.08^2 \times 17.49^2 + 4.40^2 \times 6.05^2} = 26.66$$

- The 1 day 99% VaR is  $26.66 \times 2.33 = 62.12$

# Introduction to liquidity risk

References: Banks, E. (2014). Sources of Liquidity. In: Liquidity Risk. ISBN: 978-1-137-37440-0, [on-line], Global Financial Markets Series. Palgrave Macmillan, London.  
[https://doi.org/10.1057/9781137374400\\_3](https://doi.org/10.1057/9781137374400_3)

# Common sources of asset liquidity

## Assets

## Liabilities

### Liquid assets

- **Cash and marketable securities**
  - A ready source of liquidity, either through outright sale or pledge of unencumbered securities for cash
- **Receivables**
  - A ready source of liquidity, either through outright sale (factoring) or pledge of unencumbered receivables for cash
- **Inventories**
  - An acceptable source of liquidity, either through outright sale or pledge of unencumbered inventories; most effective for standard, durable inventories

### **Fixed assets and intangibles**

#### **Fixed assets**

A possible source of liquidity, primarily through pledge of unencumbered plant and equipment for cash

#### **Intangibles**

Not a source of liquidity

## Equity

Source: Author



# Common sources of funding liquidity

Asset

Liabilities

## Short term funding

**CP, Euro CP**  
**short-term bank facilities**  
**payables**  
**deposits, repurchase agreements**  
**putable funding agreements**

Ready sources of liquidity, but ones that are more complex to manage and can be withdrawn or cancelled very rapidly

## Medium-/long-term funding

**Medium-term notes/Euronotes**  
**non-putable funding agreements**  
**bonds**  
**loans**

Ready sources of liquidity that provide a greater degree of funding stability; secured facilities remove some balance sheet flexibility

Equity

# Common sources of off-balance sheet liquidity

- Off-balance sheet

## **Securitization**

An acceptable source of liquidity, primarily through transfer of securities or receivables to conduit in exchange for cash

## **Contingent financing**

A good source of liquidity, releasing cash to be used to meet other obligations

## **Leases**

A good source of liquidity, releasing cash to be used to meet other obligations

## **Derivates**

A limited source of liquidity, primarily through off-market, synthetic, or leveraged structures that provide upfront cash or relieve funding requirements

# Key sources OF on- and off-balance sheet liquidity

## Asset

### Liquid assets

- **Cash and marketable securities**
  - A ready source of liquidity, either through outright sale or pledge of unencumbered securities for cash
- **Receivables**
  - A ready source of liquidity, either through outright sale (factoring) or pledge of unencumbered receivables for cash
- **Inventories**
  - An acceptable source of liquidity, either through outright sale or pledge of unencumbered inventories; most effective for standard, durable inventories

### **Fixed assets and intangibles**

#### **Fixed assets**

A possible source of liquidity, primarily through pledge of unencumbered plant and equipment for cash

#### **Intangibles**

Not a source of liquidity

## Liabilities

### Short term funding

CP, Euro CP  
short-term bank facilities  
payables  
deposits, repurchase agreements  
puttable funding agreements

Ready sources of liquidity, but ones that are more complex to manage can be withdrawn or cancelled very rapidly

### Medium-/long-term funding

Medium-term notes/Euronotes  
non-puttable funding agreements  
bonds  
Loans

Ready sources of liquidity that provide a greater degree of funding stability; secured facilities remove some balance sheet flexibility

## Equity

### Equity capital

N/A

## Off-balance sheet

### Securitization

An acceptable source of liquidity, primarily through transfer of securities or receivables to conduit in exchange for cash

### Contingent financing

A good source of liquidity, releasing cash to be used to meet other obligations

### Leases

A good source of liquidity, releasing cash to be used to meet other obligations

### Derivates

A limited source of liquidity, primarily through off-market, synthetic, or leveraged structures that provide upfront cash or relieve funding requirements

## Table: Corporate liquidity ratios

- Gross Working Capital = Current Assets + Current Liabilities
- Net Working Capital = Current Assets - Current Liabilities
- Current Assets = Cash + Markatable Securities + Receivables + Inventories
- Current Liabilities = Short-Term Debt Obligations + Current Portion OF Long-Term Debt + Payables
- Working Capital Ratio = Net Working Capital/Total Assets
- Current Ratio = Current Assets/Current Liabilities
- Quick Ratio = (Current Assets + Markatable Securities)/Current Liabilities
- Cash Ratio = (Cash + Markatable Securities)/Current Liabilities
- Liquidity coverage Ratio = (Current Assets - Inventories)/Average Daily Operating Expenses
- Current Liability Ratio 1 = Current Liabilities/Equity
- Current Liability Ratio 2 = Current Liabilities/Total Assets
- Current Liability Ratio 3 = Current Liabilities/Total Debt
- Average Payables Maturity (days) =  $(365 * \text{Average Payables}) / \text{Purchases}$
- Payables Turnover = Purchases/ Average Annual Payables
- Average Receivables Maturity (days) =  $(365 * \text{Average Receivables}) / \text{Sales}$
- Receivables Turnover = Sales/ Average Annual Receivables
- Capital Expenditure Coverage = Operating Cash Flow/ Capital Expenditure

# Fixed/liquid asset limits

## Asset

## Liabilities

## Equity

- **Total liquid assets**
  - Minimum of x% or x\$ of total assets
- **Cash and marketable securities**
  - Minimum of x% or x\$ of total assets
- **Receivables**
  - Minimum of x% or x\$ of total assets
- **Inventories**
  - Maximum of x% or x\$ of total assets
- **Total fixed assets**
  - Maximum of x% or x\$ of total assets

# Liquid asset limits

Asset

Liabilities

- **Total liquid assets**

- Minimum OF x% or x\$ of total assets

Subportfolio 1  
Subportfolio 2  
Subportfolio 3

Equity

**Concentration**

Maximum of x% or x\$ of total assets

**Maturity**

Minimum of x% or x\$ of total assets in short-term maturity/duration, per bucket  
Maximum of x% or x\$ of total assets in medium/long-term maturity/duration, per bucket

**Quality**

Maximum of x% or x\$ of total assets per rating as complex

**Complexity**

Maximum of x% or x\$ of total assets per rating as complex

**Aging**

Maximum of x% or x\$ of total assets classified as aged (e.g. Over 60, 90, 180 days)

# Collateral/pledging limits

Asset

Liabilities

**Total liquid assets**

Maximum of x% or x\$ of total liquid assets pledged as collateral

**Cash and marketable securities**

Maximum of x% or x\$ of total cash/securities pledged as collateral

**Receivables**

Maximum of x% or x\$ of total receivables pledged as collateral

**Inventories**

Maximum of x% or x\$ of total inventories pledged as collateral

**Total fixed assets**

Maximum of x% or x\$ of total assets pledged as collateral

Equity

# Diversified funding limits

Asset

Liabilities

- **Total funding sources**

Equity

**Markets**

Maximum of x% or x\$ of total funding from a single market

**Products**

Maximum of x% or x\$ of total funding from a single product

**Maturity**

Maximum of x% or x\$ of total funding in short-term maturity/duration, per bucket

Minimum of x% or x\$ of total funding in medium/long-term maturity/duration, per bucket

**Lenders/investors**

Maximum of x% or x\$ of total funding from a single lender and per rating



# Committed facility limits

Asset

Liabilities

- **Total bank funding sources**

Equity

**Off-balance sheet  
funding commitments**

**Advised facilities**

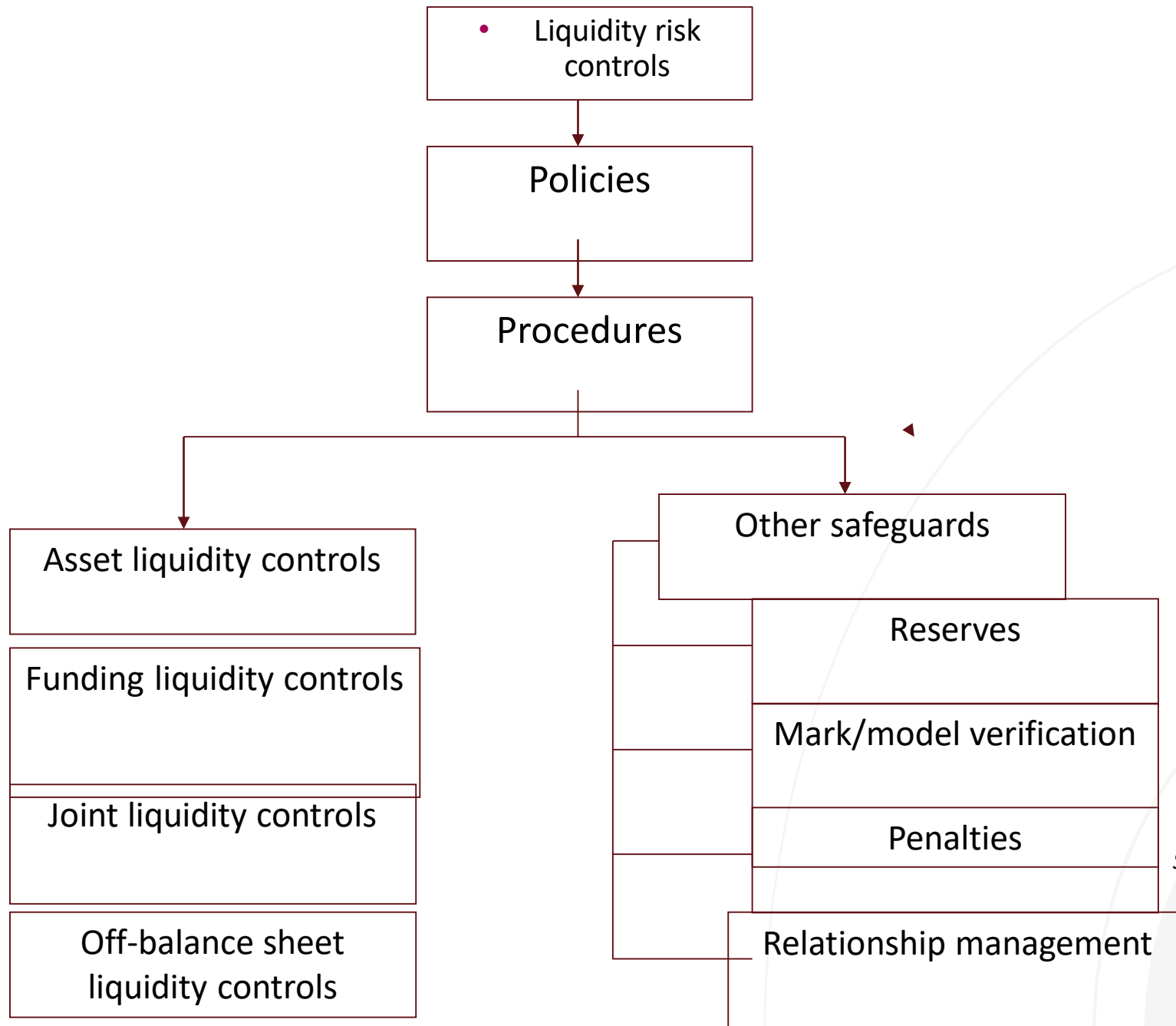
Maximum of x% or x\$ of total funding from advised facilities

**Comitted facilities**

Maximum of x% or x\$ of total funding from committed facilities  
(dependent on covenants, MACs\*)

\*may also apply to capital markets issues

# Liquidity risk controls



Source: Author