Risk Management
11: Case Studies

- Unit 11.1: Risk management disasters
- Unit 11.2: Examples of good practice

11.1: Risk management disasters

Reading:

- Hull (Risk Management): Chapter 6 (2007/8 credit crunch)
  + business snapshots
- Hull (Derivatives, 6th edition): Chapter 32 (Derivatives mishaps)
- Crouhy: short sections on: Bankers Trust; Barings Bank; Merrill-Lynch; Nat West Bank; Niederhoffer; LTCM; Orange County.
- Sweeting: Chapter 20

Unit 11.2: Examples of good practice

Reading:

- Hull (Risk Management): business snapshots
- IAA Practice Note: Appendix 3; Appendix 4-6
- Lam: Chapter 14 (Operational Risk) pages 264-270
- Company financial reports: look for a description of their risk management frameworks and risk appetite

Case Study – Swiss Re

- ERM action to reduce the impact of extremes
- Swiss Re Mortality bond: Vita Capital
  first issued in 2004
- Objectives:
  - To reduce regulatory and/or risk capital and enhance return on capital
  - As part of an overall package of good ERM

Aim: to reduce exposure to extreme mortality events

- Pandemic
  (e.g. 1 in 200 year event $\Rightarrow$ CHF 4.0 Billion loss)
- Major terrorist attack
- Tsunami
- Earthquake

Risks (simplified description)

Swiss Re opted for a *parametric-index* security linked to national mortality in 5 countries

in preference to link to Swiss Re's own mortality experience

Parametric index $\Rightarrow$

- avoid moral hazard
- much better historical data
  $\Rightarrow$ investors have greater confidence in the risks being taken on
- avoid revealing commercial information about Swiss Re's customers

Risks (simplified description)

- $M(c, g, t, x)$ = national mortality rate by:
  - country, c
  - gender, g
  - year, t
  - age, x
-

$$L(c, g, t, x) = \text{Swiss Re actual } (c, g, t, x) \text{ net losses}$$

$$= \sum_{i=1}^{n(c,g,t,x)} \{D_i(c, g, t, x)C_i(c, g, t, x) - P_i(c, g, t, x)\}$$

Risks (simplified description) (cont.)

- $n(c, g, t, x)$ = number of individuals from country c, gender g and age x in year t in Swiss Re's portfolio of liabilities
- $i = 1, \ldots, n(c, g, t, x)$ represents individuals in the (c, g, t, x) group
- $D_i(c, g, t, x)$ = indicator random variable for individual i in group (c, g, t, x). Equals 1 if the individual dies or 0 otherwise.
- $C_i(c, g, t, x)$ = claim resulting from the death of individual i in group (c, g, x) in year t
- $P_i(c, g, t, x)$ = reinsurance premium payable to Swiss Re in respect of individual i in group (c, g, x) in year t

Mortality bond

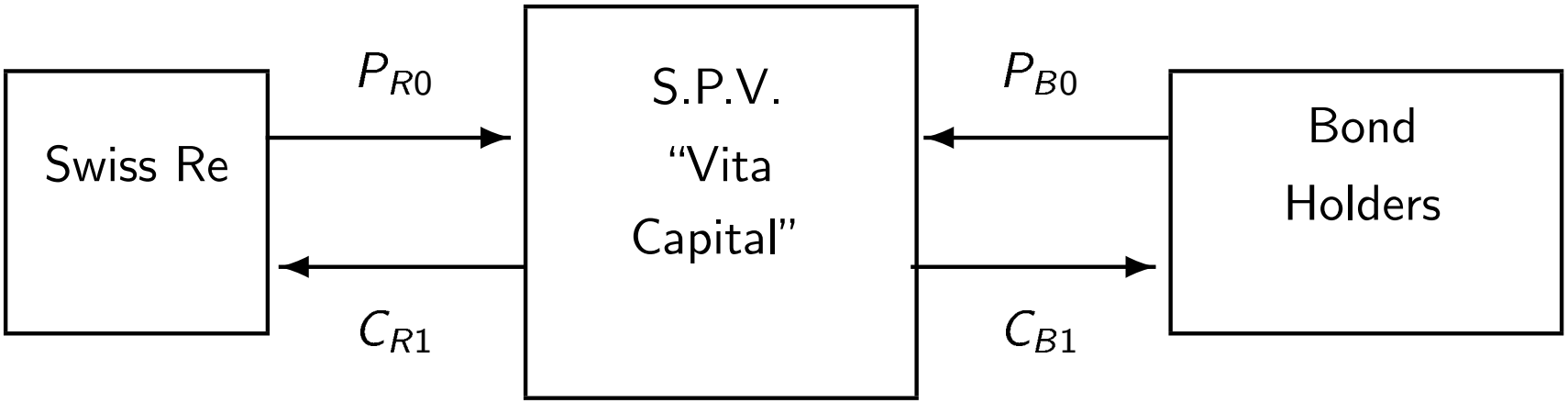
$$\text{Mortality index:} \quad m(t) = \frac{\sum_{c,g,x} w(c,g,x) M(c,g,t,x)}{\sum_{c,g,x} w(c,g,x)}$$

- $w(c,g,x) =$ weights specified in the contract
- $L(t) = \sum_{c,g,x} L(c,g,t,x) =$ Swiss Re's own aggregate net loss in year t
- Choose $w(c,g,x)$ to maximise $\text{cor}\Big(m(t), L(t)\Big)$

Mortality bond (cont.)

- Weights chosen to minimise basis risk between $L(t)$ and $m(t)$
- Basis risk
  - wealthier subpopulation
  - fewer lives
  - concentration risk by:
    $C_i(.)$;
    region/city/building

Details



- Coupon: LIBOR +135 basis points (2004), default free
- m_0 = base mortality index for year 0
- Repayment of principal:
  - 100% if $m(t) \leq 1.3 \times m_0$ for $t = 1, 2, 3$
  - $100(m(t) - 1.3m_0)/0.2m_0$ if $1.3m_0 < m(t) \leq 1.5m_0$
  - 0 if $1.5m_0 < m(t)$

Details

- Reduction in principal paid to Swiss Re instead $\Rightarrow$ payment to Swiss Re in an extremely bad year
- $1.3\times$, $1.5\times \Rightarrow$ *Attachment, Detachment Points*
- High threshold $\Rightarrow$ low cost to Swiss Re
- Spanish Flu 1918-20
  - Came close to $1.3\times$
  - Biggest impact at younger ages
  - 2000's: equivalent risks: Bird flu, then swine flu
- Covid-19 pandemic 2020-2021
  - UK around $1.1 - 1.2\times$ in 2020
  - Covid death rates proportional to all-cause mortality by age and socio-economic group
  - Conversely: highly variable by region $\Rightarrow$ basis risk

Details

- Investors
  - specialist hedge funds (+135b.p.'s)
  - pension funds (corr(mortality,longevity)<0)
- Catastrophe risk $\Rightarrow$
  - significant correlation across (c, g, x) depending on type of event
    $\Rightarrow$ tail dependency is important
- Bond was successful: more mortality CAT bonds followed

  See, `www.artemis.bm/deal-directory/`

Summary

There are many documented case studies:

- learn about past disasters: what went wrong and how to avoid similar things from happening again?
- but also don't focus on avoiding exactly the same mistake as the next disaster will almost certainly be different
- read examples of good practice: what has been done and why?
- Build on these case studies to propose or develop risk management solutions for a variety of scenarios