Catastrophic Mortality Bonds – an effective hedge?

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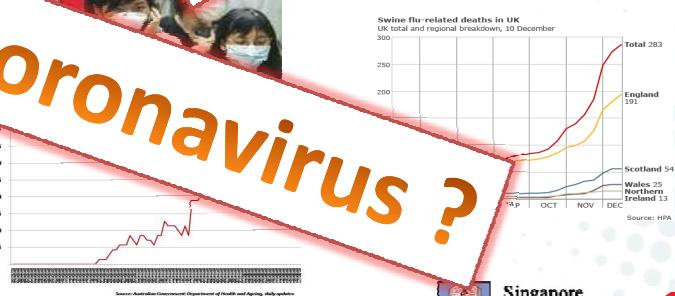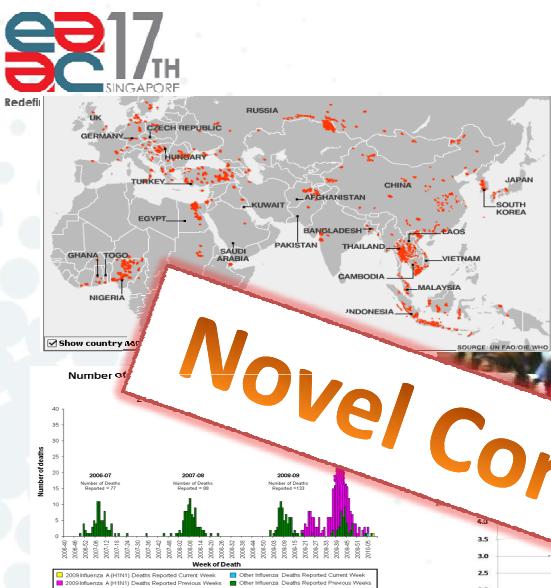
Agenda

- What causes catastrophic mortality?
- What is a Catastrophic Mortality Bond?
- What did we do?
  - Built a Life portfolio
  - Calibrated a cat bond
  - Ran sensitivities and examined HE

Catastrophic mortality

- Natural catastrophes
- Industrial accidents
- War
- Terrorism
- Pandemic

MASSACRE BY POISON GAS

Many die, 1,200 collapse in Tokyo Tube attack

Pandemic influenza

Table 1: Estimated global and U.S. excess mortality rates for the influenza pandemics of the 20th and 21st century

Name	Global excess mortality rate (per 1,000) [a]	U.S. excess mortality rate (per 1,000) [a]
1918-1919 Spanish Flu	27.60 – 55.20	4.81 – 6.50
1957-1958 Asian Flu	0.34 – 0.69	0.38 – 0.46
1968-1969 Hong Kong Flu	0.28	0.14 – 0.17
2009-2010 H1N1 Flu	N/A	0.02 – 0.14

Sources: Dauer & Serfling (1961); Glezen (1996); Simonsen et al. (1998); U.S. Census Bureau (2000, 2011a, 2011b); U.S. Department of Health & Human Services (2011); United Nations (1999); Viboud et al. (2010); World Health Organisation (2005)
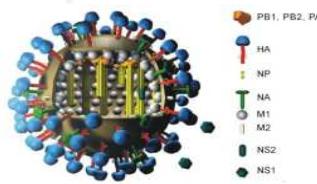
One scenario
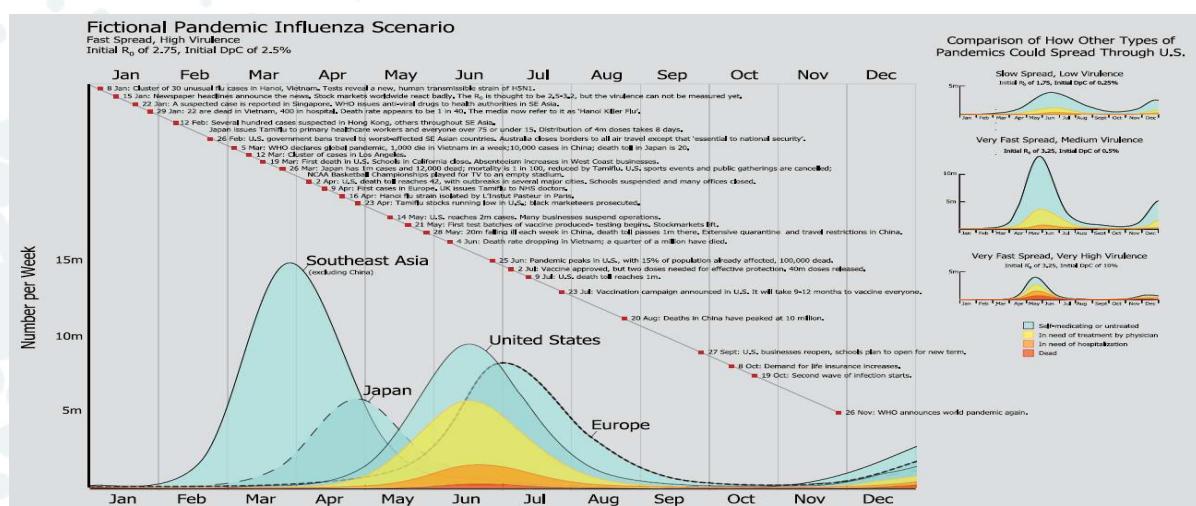
Source: RMS, Managing Influenza Pandemic Risk, 2007

Catastrophic mortality bond

- Alternative or complement to reinsurance
- Insurer issues a bond instead of taking out, say, Stop Loss reinsurance
- But, bonds to date are parametric, ie based on a population index, and do not indemnify

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Mechanism overview

Mortality Index
- Based on age and gender weighted death rates
- Based on national index(es) of mortality
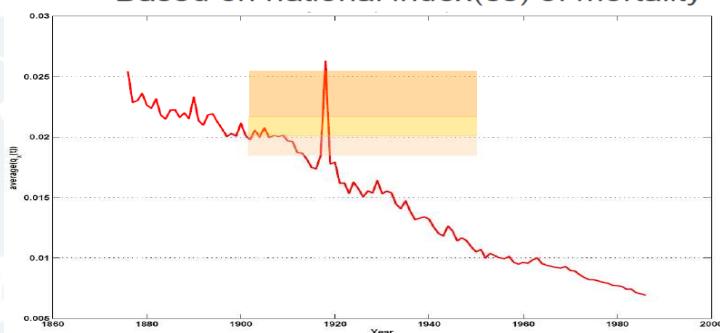
	VITA III
Sponsor	Swiss Re
Year	2006
Mortality Index	62.5% United States 17.5% United Kingdom 7.5% Germany 7.5% Japan 5% Canada
Risk Period	4 and 5 years
Index Calculation	2-year average
Trigger / Exhaustion Levels (% of Base Index)	A: 125% / 145% B: 120% / 125% C: 115% / 120% D: 110% / 115%

Source: Swiss Re

Mechanism overview

- Reduction in outstanding Principal of the Bond
  - Index < Attachment point → Principal repayable in Full
  - Index > Exhaustion point → Principal completely exhausted
  - Linear Reduction between Attachment point and Exhaustion point
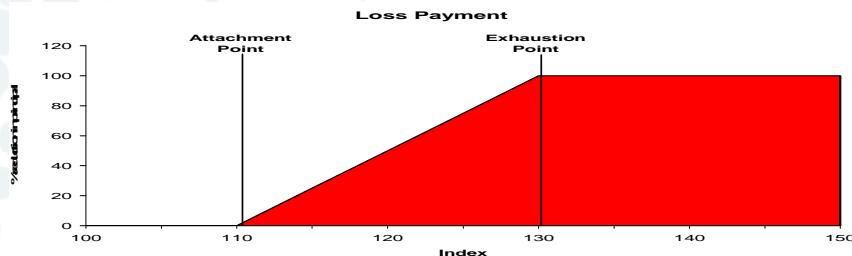
Source: Bridet, IAA Life Munich 2009

What did we do?

Forecast mortality rates for the insured and general population
- Baseline mortality rate model
- Influenza pandemic excess mortality rate model

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Calculation of cash flows
- Life insurer's claims model
- Catastrophic mortality bond payoff model

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Evaulation of hedge effectiveness
- Hedge effectiveness model

Mortality modelling

- Baseline mortality (including improvements)
  - Irrelevant (some secondary effects)
- Pandemic influenza excess mortality
  - Overall level/intensity
  - Age-specific distribution ie "shape"
  - General population vs insured population

Life portfolio

- Typical term life assurance
- 20 000 policies for tractability

	Male	Female	Total
Number of policies	12,406	7,594	20,000
Average Age	43	40	42
Average Sum Insured	$420k	$ 270k	$365k
Expected Claims 2011	$5.7m	$1.4m	$7.1m

- 10 000 simulations

Base pandemic scenario

- Occurs in 2013 and lasts for 1 year
- Population excess mortality 1.5 per mille
- Insured mortality experience is 80% of general population mortality
- Shape is as per Spanish Flu

Calibrated catastrophic mortality bond

Bond characteristics	
Risk Period Start	1 Jan 2011
Bond Tenor	5 years
Principal	$6.5m
Attachment Point	122.33% (1 per mille excess)
Exhaustion Point	151.77% (2 per mille excess)

Hedge effectiveness measure

The hedge effectiveness, HE, is calculated as follows:

$$HE = 1 - \frac{AC - RC - CMBP}{AC - RC}$$

Where:

HE	=	The hedge effectiveness;
AC	=	The aggregate claims;
RC	=	The retained claims; and,
$CMBP$	=	The catastrophic mortality bond payoff(s).

Results

- Base
- A. With bond recalibration:
  1. Increase number of policies
  2. Uniform Sum Insured
- B. No bond recalibration:
  1. Increase/decrease age profile
  2. Mortality Improvement
  3. Pandemic intensity
  4. Pandemic shape
 5. Ratio of general to insured population excess mortality

Base scenario
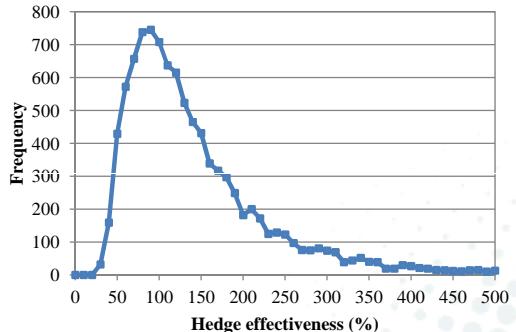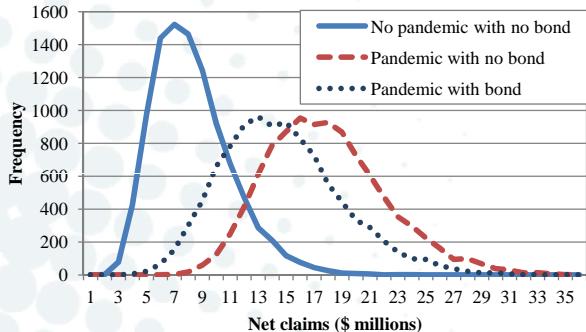
Scenario	Estimated mean of net claims ($ Millions)	Estimated variance of net claims ($ Millions^2)
No pandemic with no bond	6.77	7.77
Pandemic with no bond	16.38	18.35
Pandemic with bond [a]	13.15	18.35

A1. Increase number of policies
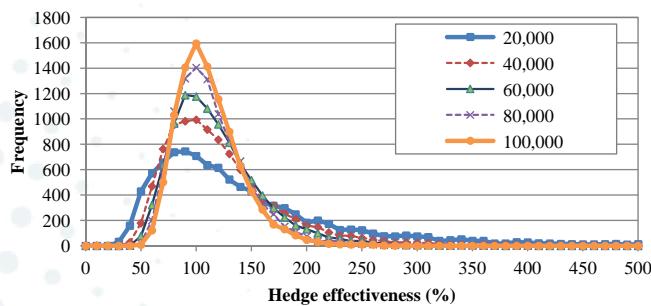
Number of policies	Estimated hedge effectiveness (%)		
	Mean	Median	5th percentile
20,000	153	115	48
40,000	119	107	57
60,000	114	106	62
80,000	109	103	65
100,000	107	102	68

A2. Uniform sum insured
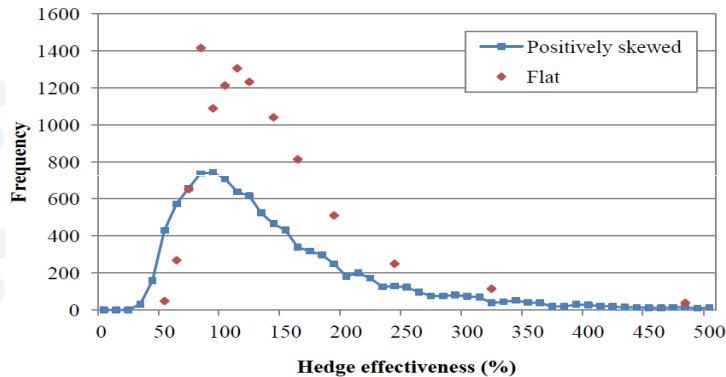
Distribution of sum insured by age and gender	Estimated hedge effectiveness (%)		
	Mean	Median	5th percentile
Positively skewed	153	115	48
Flat	114	105	63

B1. Increase/decrease age profile
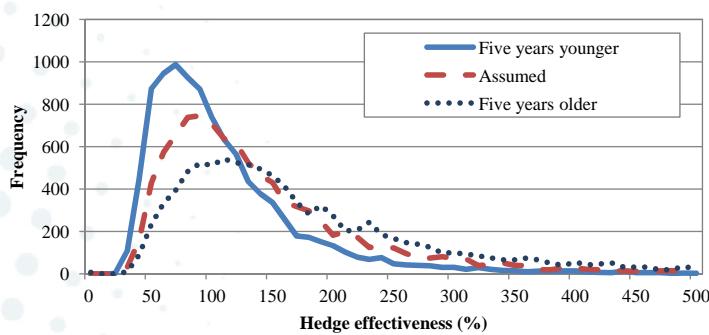
Portfolio composition by age and gender	Estimated hedge effectiveness (%)		
	Mean	Median	5th percentile
Five years younger	110	88	39
Assumed	153	115	48
Five years older	217	147	55

B2. Mortality improvement
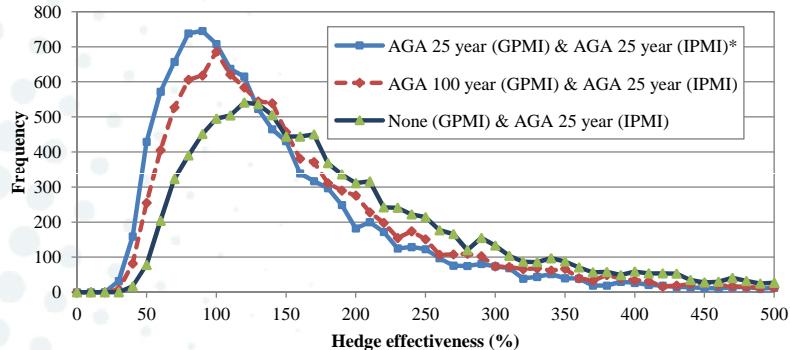
| General population mortality improvement	Insured population mortality improvement	Estimated hedge effectiveness (%)		
		Mean	Median	5th percentile
AGA 25 year	AGA 25 year	153	115	48
AGA 100 year	AGA 25 year	174	131	54
None	AGA 25 year	214	161	67

B3. Pandemic intensity
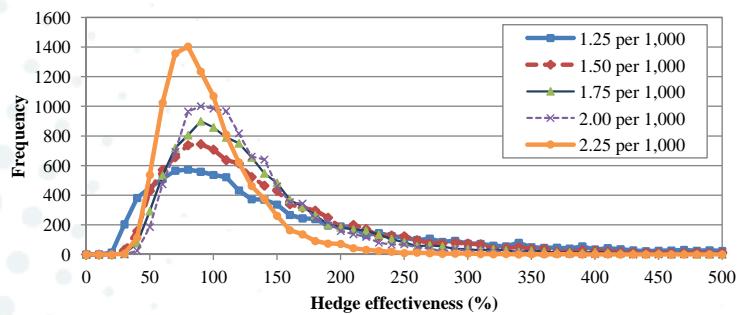
Overall general population excess mortality rate (per 1,000)	Estimated hedge effectiveness (%)		
	Mean	Median	5th percentile
1.00	0	0	0
1.25	250	125	37
1.50	153	115	48
1.75	129	110	53
2.00	120	107	57
2.25	93	84	48

B4. Pandemic shape
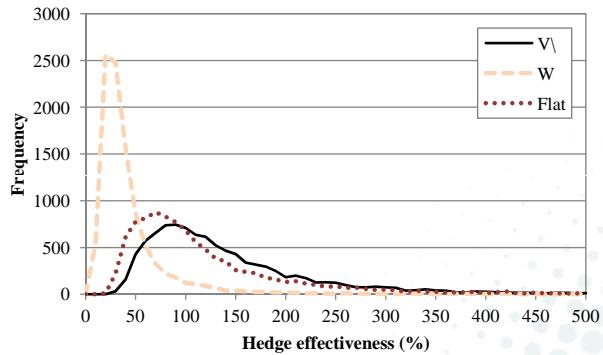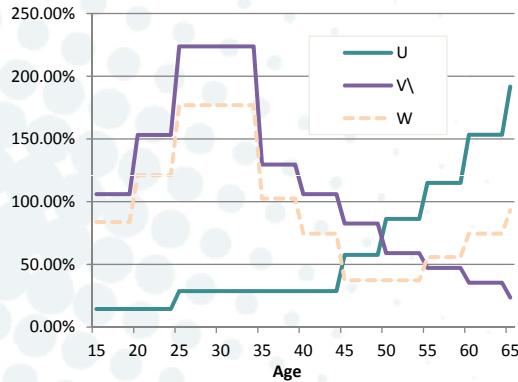
Age-specific distribution of excess mortality rates	Estimated hedge effectiveness (%)		
	Mean	Median	5th percentile
V\	153	115	48
U	0	0	0
W	42	27	10
Flat	134	91	35

B5. Insured vs general pop'n
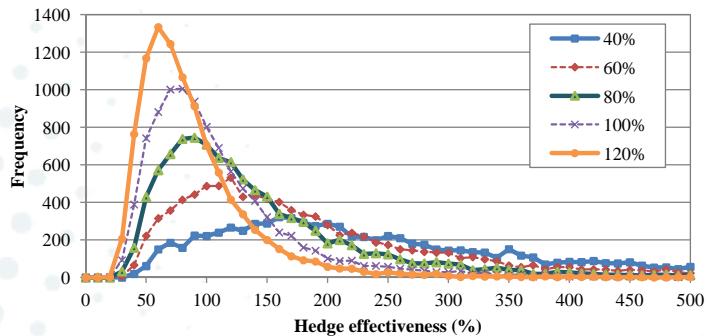
Excess mortality rate ratio of insured versus general population	Estimated hedge effectiveness (%)		
	Mean	Median	5th percentile
40%	521	250	76
60%	245	160	57
80%	153	115	48
100%	110	89	40
120%	86	72	35

Conclusion

- Basis risk is an issue for these instruments
- The obvious insight:
  - Best for largest portfolios
- The slightly less obvious insight:
  - Combination with surplus reinsurance
  - Pooling of smaller players