



ASSOCIATION ACTUARIELLE INTERNATIONALE
INTERNATIONAL ACTUARIAL ASSOCIATION

13th Global Conference of Actuaries 2011

Emerging Risks... Daring Solutions



Institute of Actuaries of India

Longevity & the Implications for the Insurance Industry

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Chief Actuary, Munich Re - Life Asia

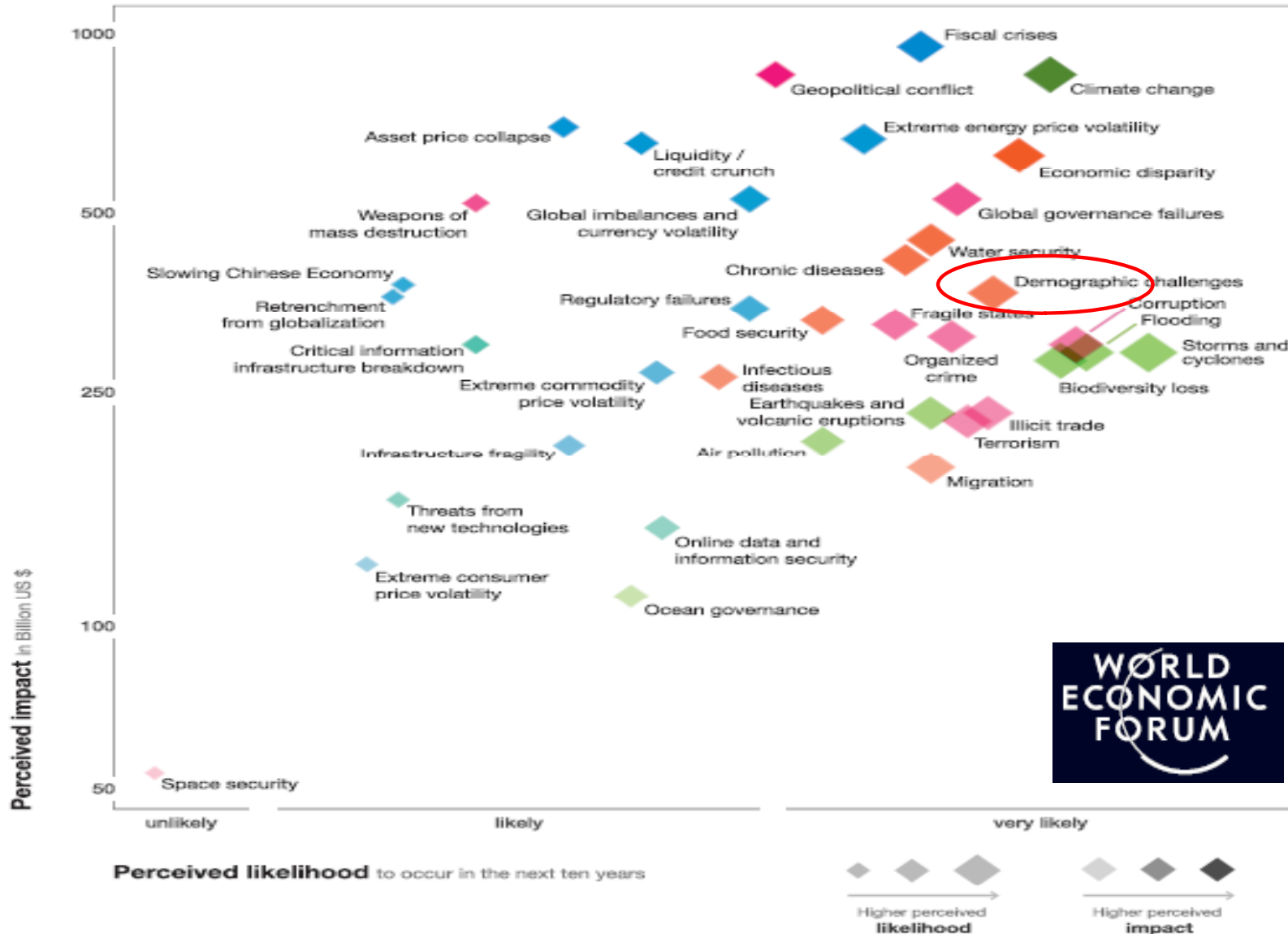
Singapore



February 20 – 22, 2011

Global Risks Landscape 2011...

demographic challenges – especially aging, is high on the list...



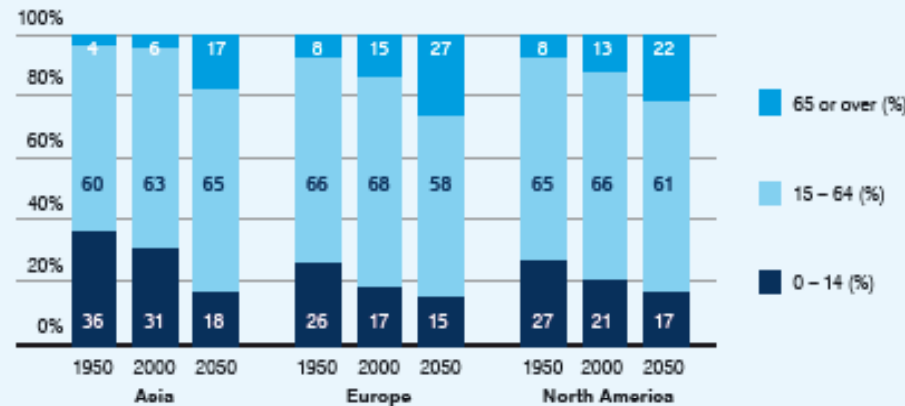
Longevity is a Key Emerging Risk...

CRO Forum recently issued a position paper...



A visualization of the FOXO3A ('Methuelah') gene section, which plays a key role in determining lifespan. It is also involved in lipid metabolism and cell death processes.

Figure 2.1 Emerging global demographic changes, showing age distribution of Asia, Europe and North America, 1950-2050



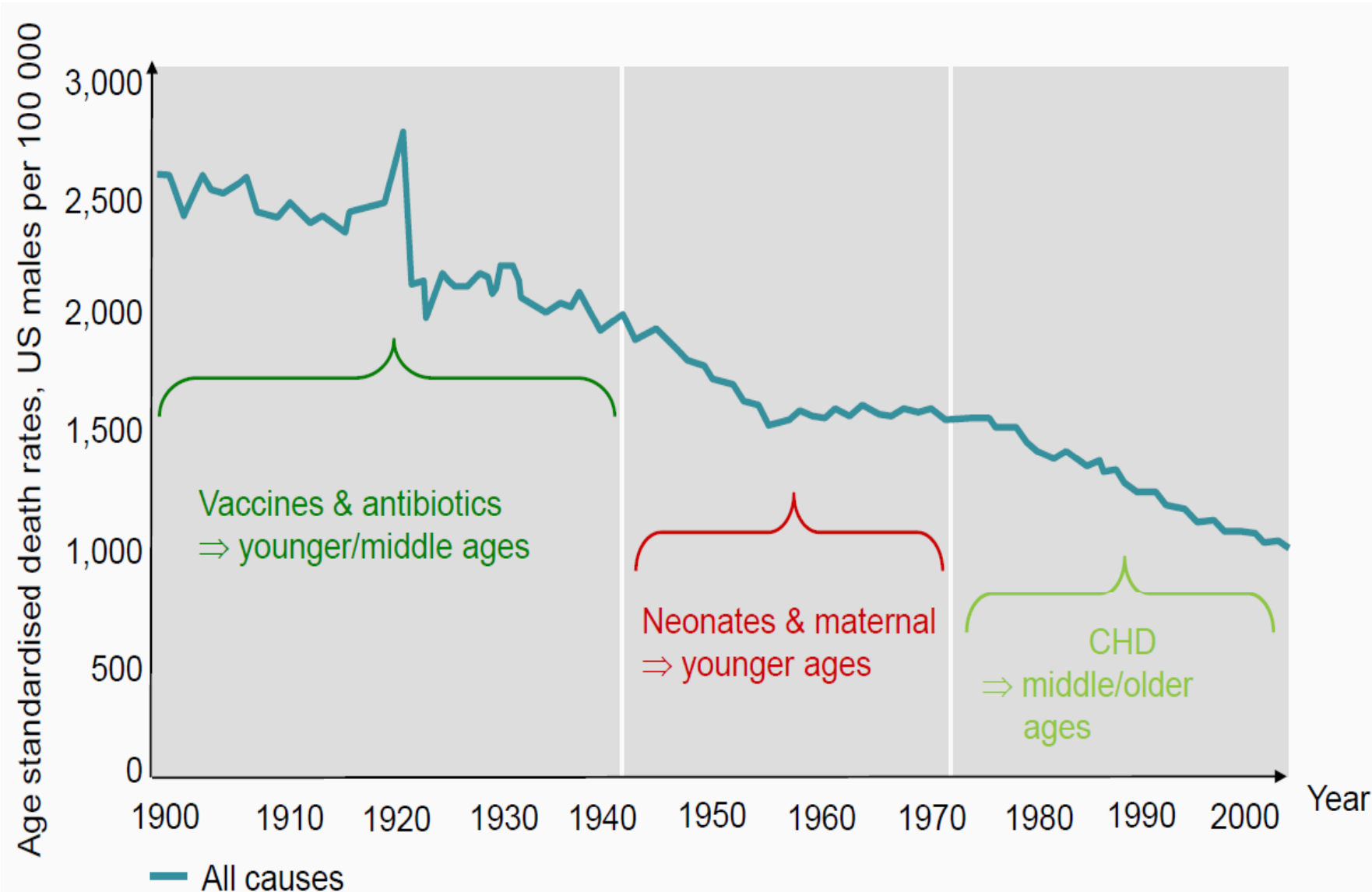
Source: United Nations, World Population Prospects 2008 Revision

Longevity
 CRO briefing
 Emerging Risks Initiative - Position Paper
 November 2010

	Factors which could increase longevity	Factors which could reduce longevity
Lifestyle	<ul style="list-style-type: none"> Fewer smokers Improved diets Regular exercise 	<ul style="list-style-type: none"> Rise in obesity More stress Less physical activity
Medicine	<ul style="list-style-type: none"> Development of drugs tackling life-threatening conditions (e.g., statins) Lower accident mortality Discovery of an effective gene therapy 	<ul style="list-style-type: none"> Viruses and bacteria develop resistance to available drugs
Disease	<ul style="list-style-type: none"> Improved survival rates of, for example, cancer or heart disease 	<ul style="list-style-type: none"> New diseases/viruses evolve Pandemics Diabetes

Development of Mortality in the 20th Century

with advances in medicine...

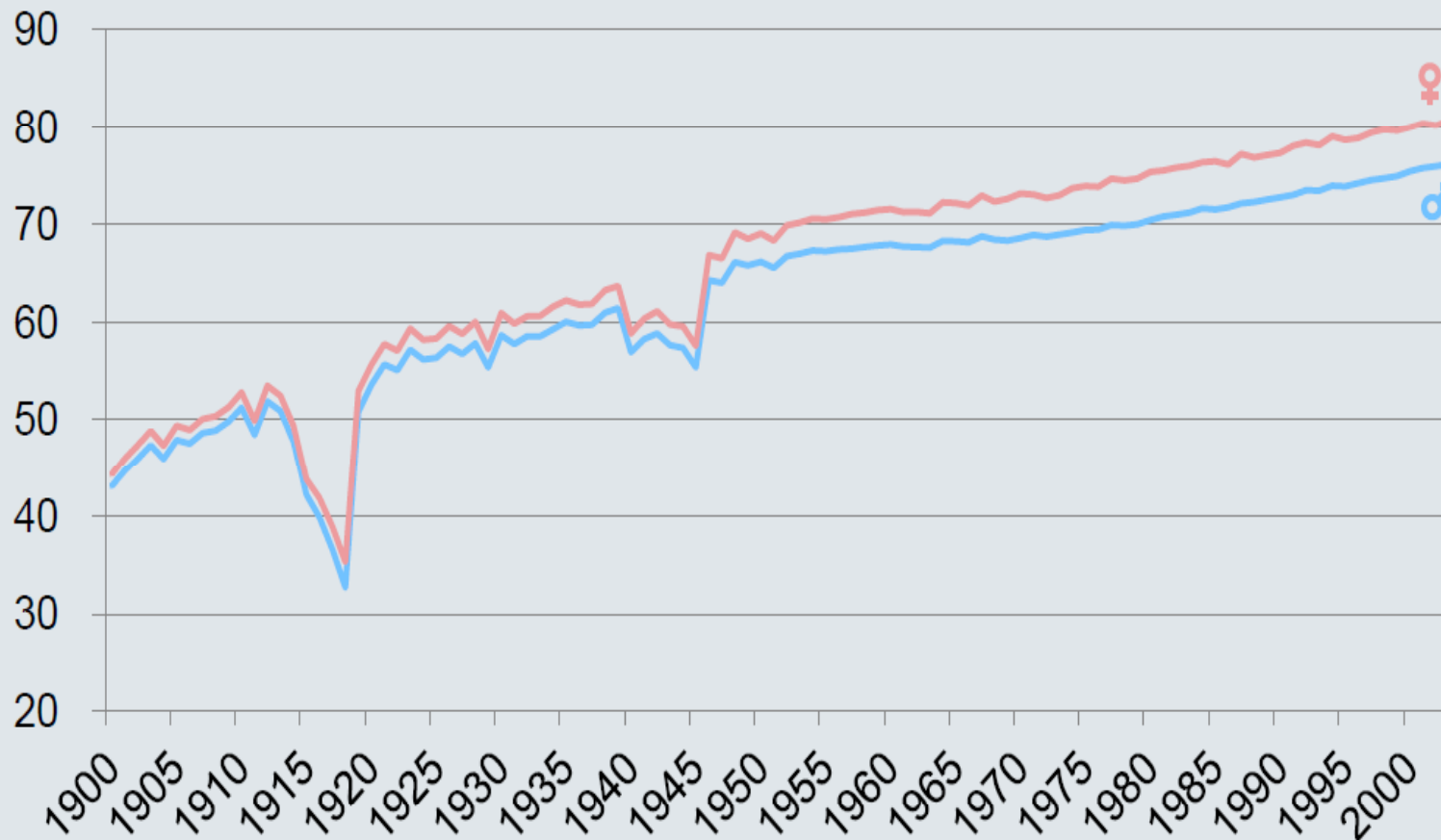


UK Life Expectancy at Birth

the trend is clear...



Life Expectancy from Birth in ages



Japan Population Projections

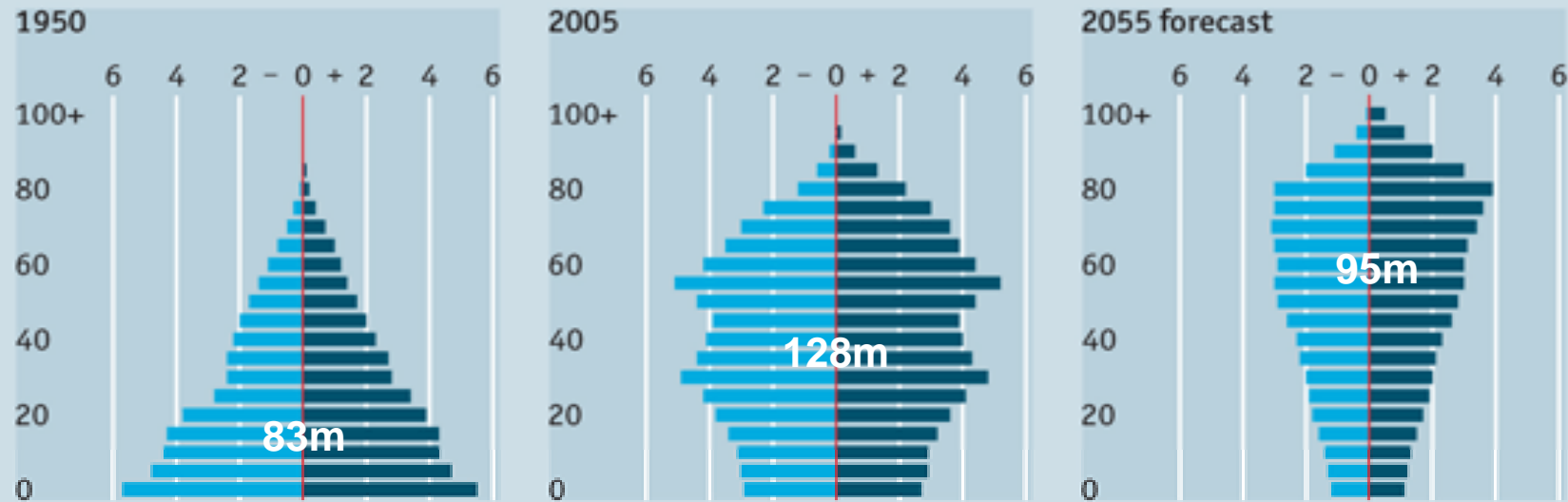
rapid change in 100 years...



1

From pyramid to kite

Japan's population by age group, m



Source: National Institute of Population and Social Security Research



Source: Special Report:
Japan

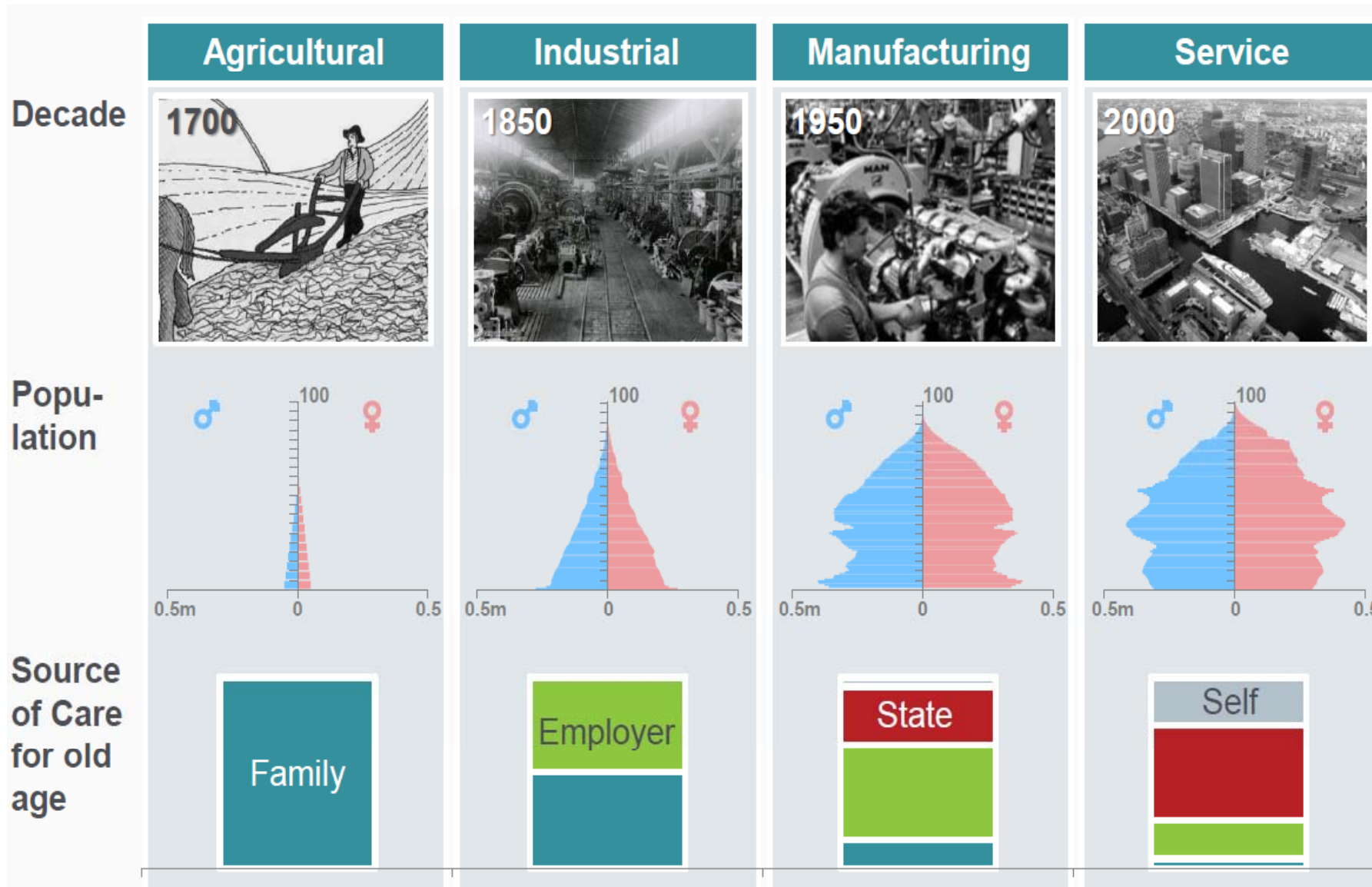
The
Economist

13th Global Conference of Actuaries 2011

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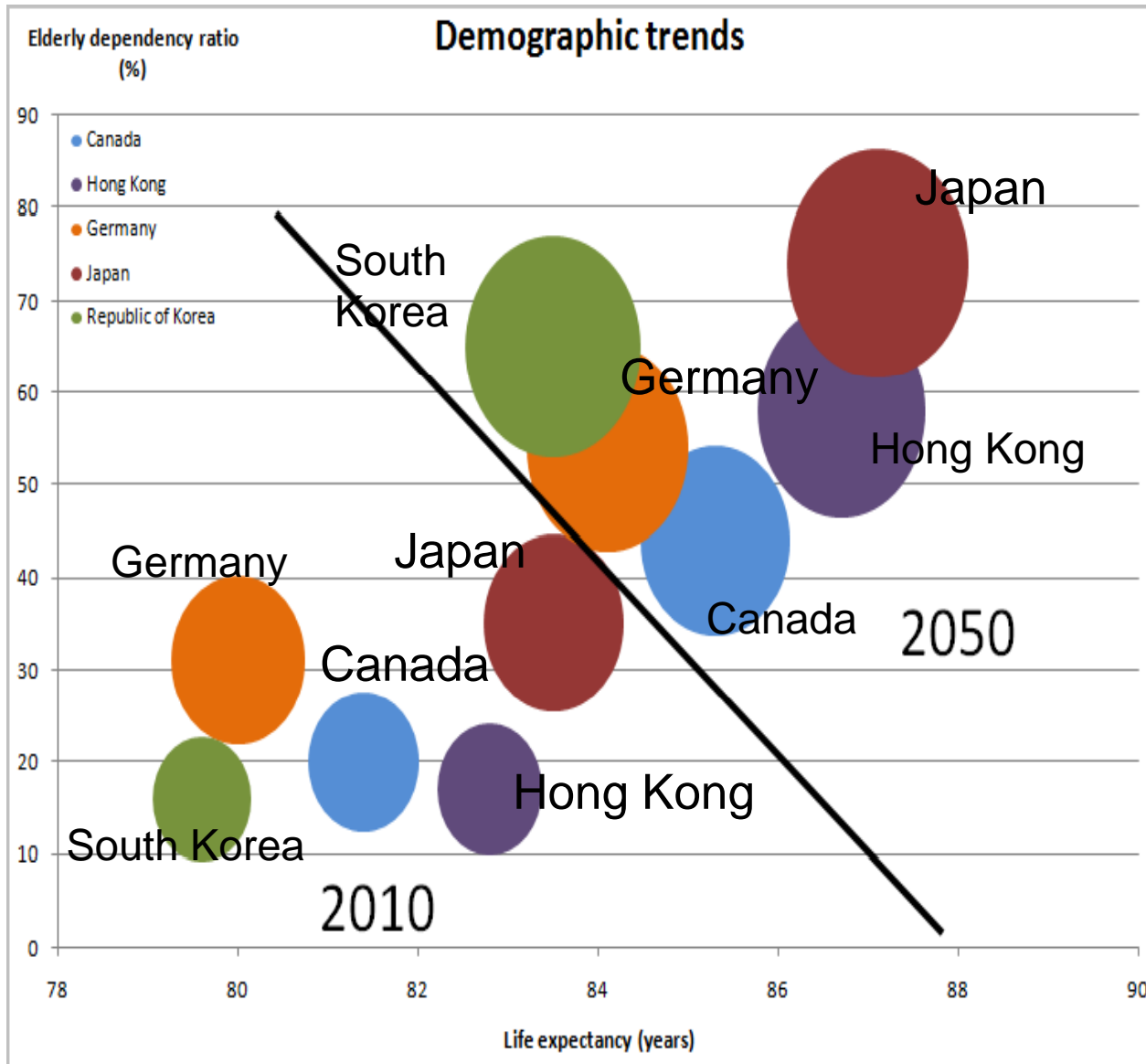
Evolution of Old Age Care in the UK

driven by economic & demographic changes....



Demographic Trends from 2010 to 2050

changes around the world....



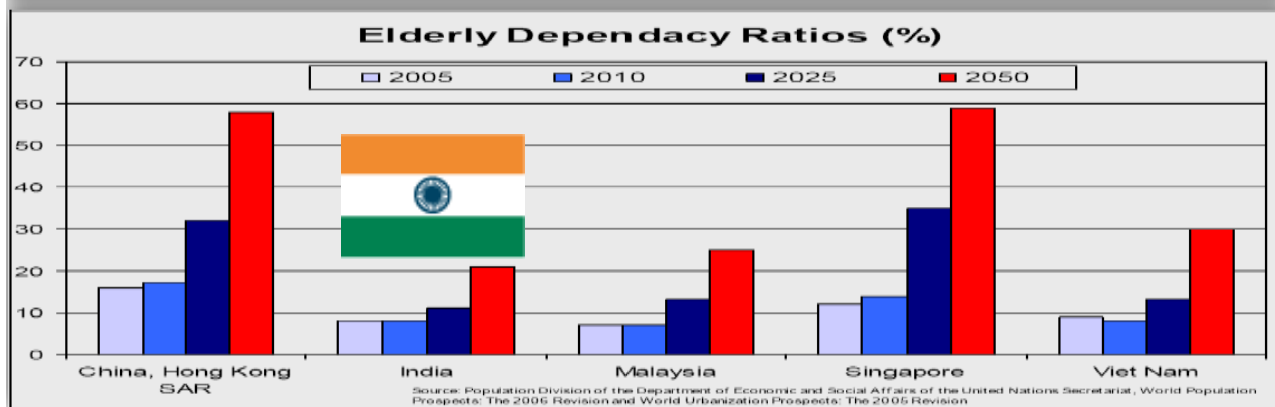
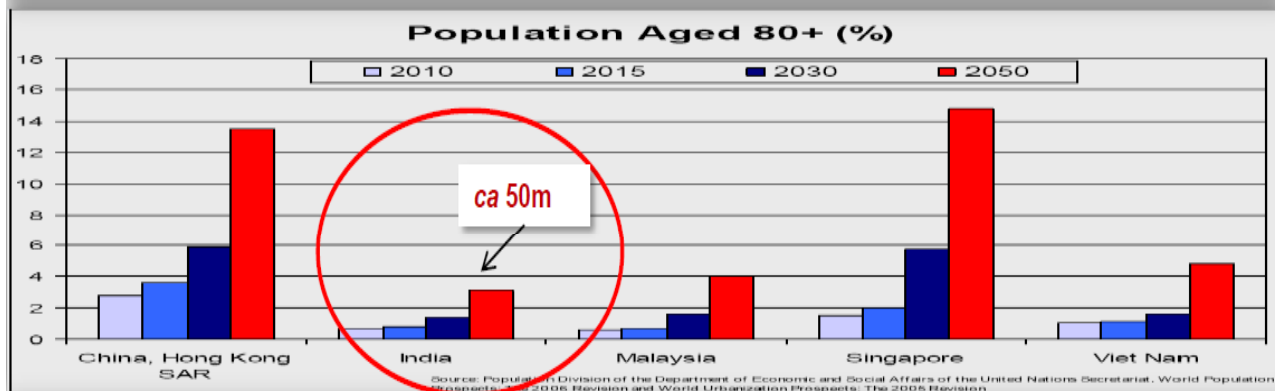
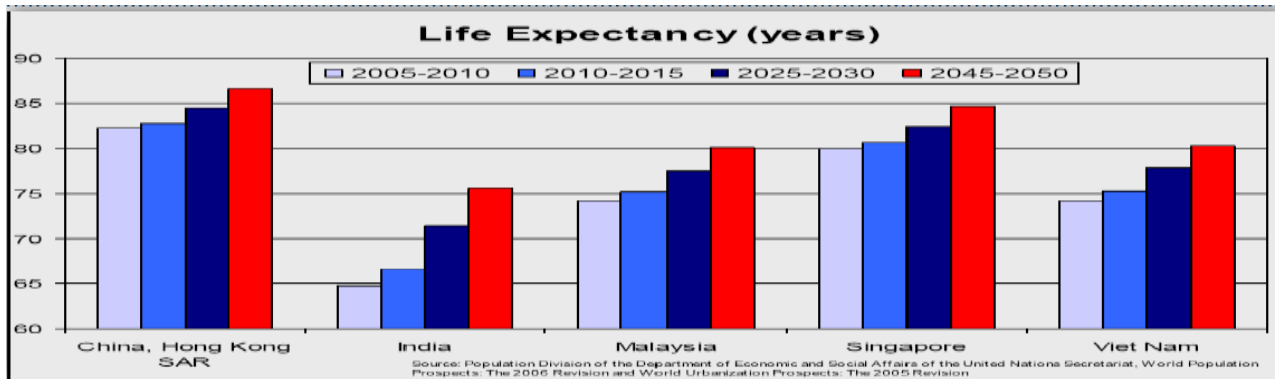
□ The larger the bubble, the higher the **percentage of the population aged over 65**.

□ The further the bubble is to the right, the **longer the life expectancy**, and

□ the higher up the chart, the higher the **elderly dependency ratio** (the ratio of people over age 65 divided by the working population).

Longevity Risk Context in Asia...

one of the biggest challenges to the insurance industry...



**INCREASING
LONGEVITY
RISK...**

Living Longer

(More time to contract
a critical illness / disability)

+ Over aged 80

(Users of Long Term Care)

**+ Increased
Dependency Ratio**

(Less tax payers to pay for
government benefits or

family support)

Population Aging in India

also likely to show rapid change....



Figure 2. Life expectancy in India is rising at a good pace

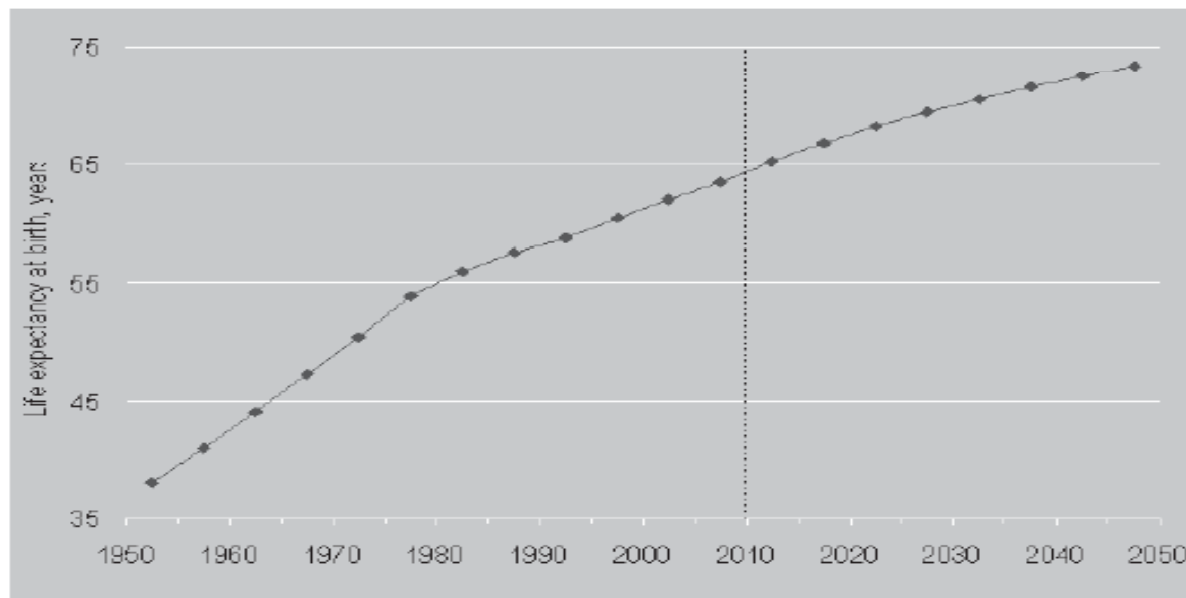
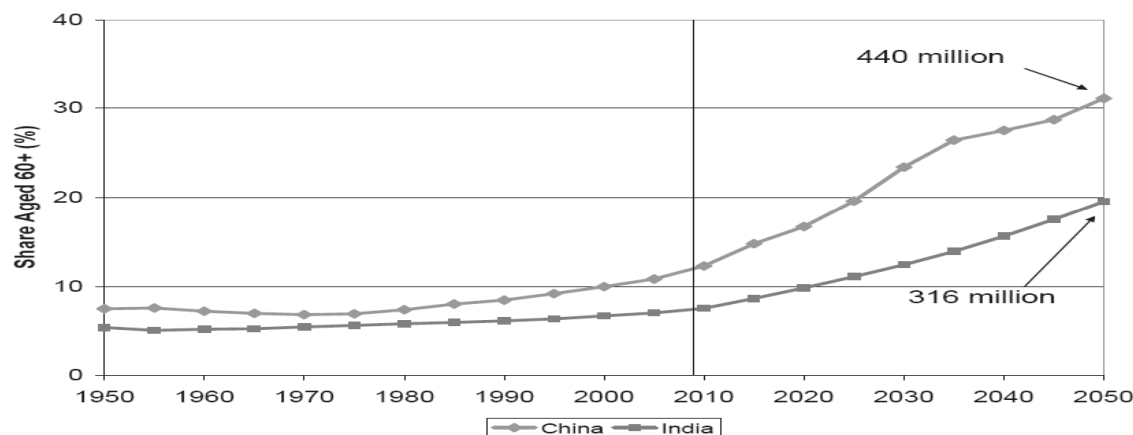


Figure 3
Population Aging in China and India



WDA Forum University of St.Gallen

The WDA – HSG Discussion Paper Series
on Demographic Issues

Economic Security Arrangements in the Context of Population Ageing in India

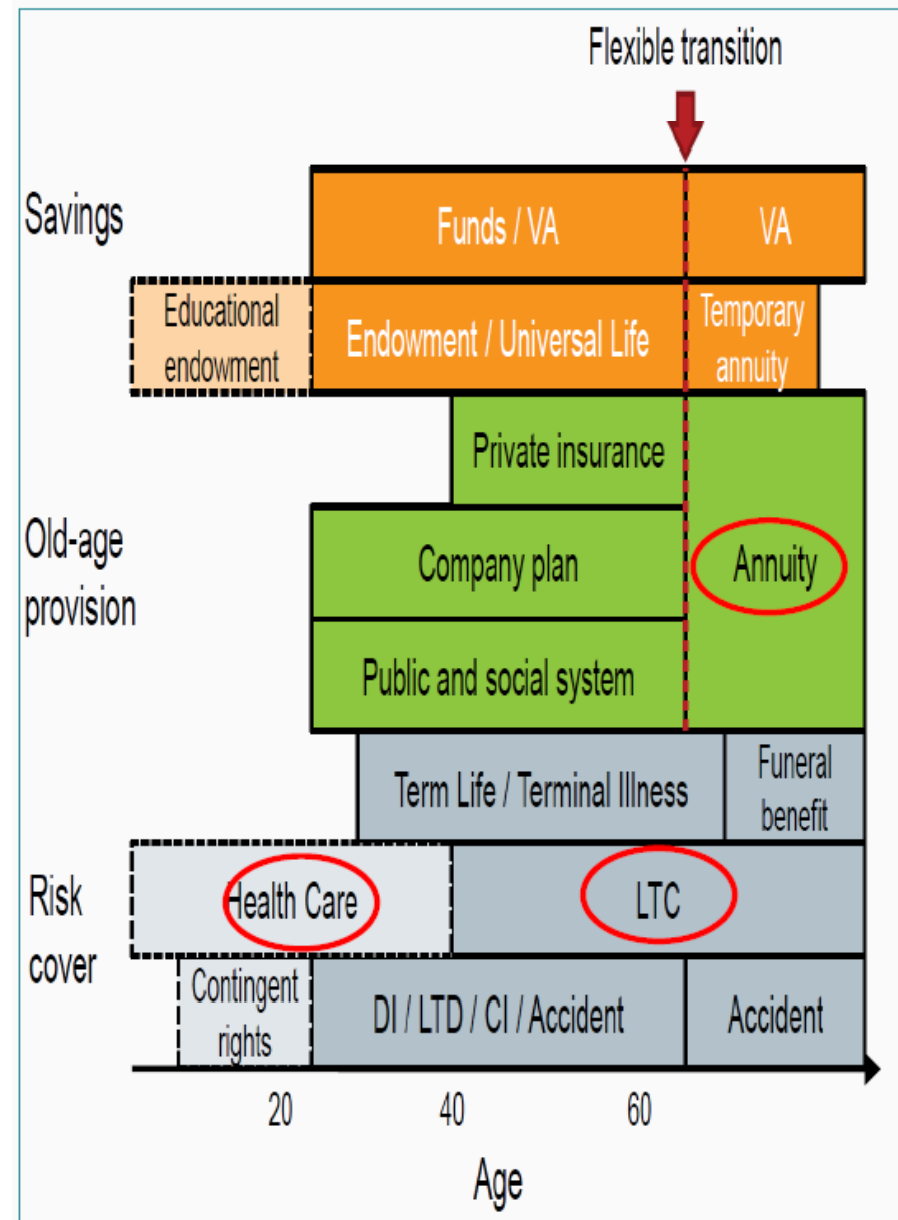
by David E. Bloom, Ajay Mahal, Larry Rosenberg and Jaypee Sevilla

No. 2010/8



Impact of Changing Demographics on Products & Liabilities

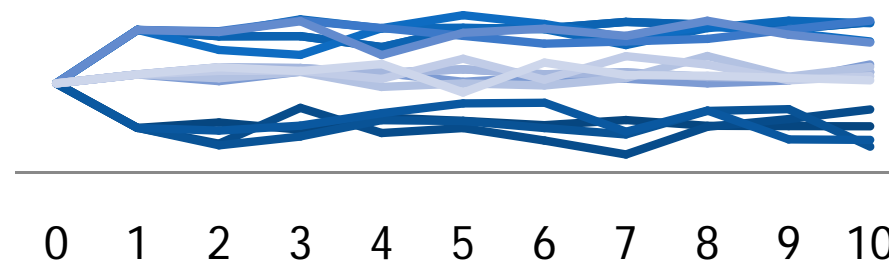
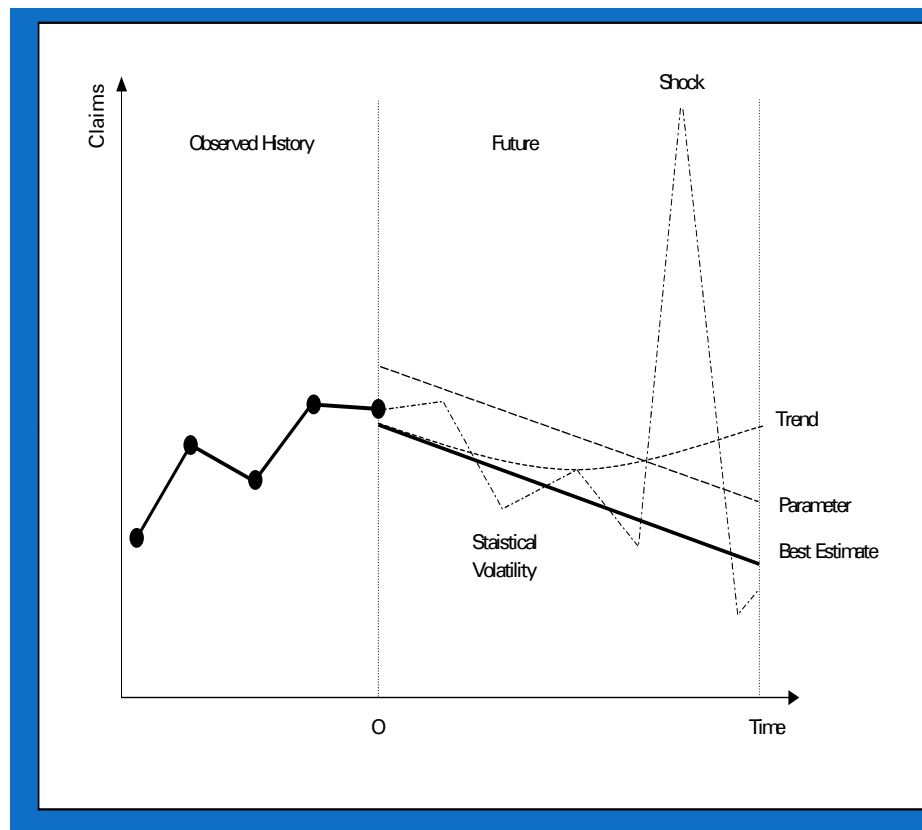
- Income **annuity** products will be in higher demand – evidence already in Japan & Korea
- Care Products like **medical** products & **LTC** will be in greater demand as populations age & social structures change
- Other products targeted at the older ages – **secondary guarantee UL**; **reverse mortgages**; etc.
- Decreased mortality can mean higher **morbidity** – DI/CI/LTC
- Also higher disabled life **reserves**
- **Pricing** and **Reserving** – need modern mortality tables with trend factors...
- Liabilities **duration** will be extended - will there be available assets to match this?
- ERM – need to understand deeply the **nature** of longevity risk....



Understanding the Nature of Longevity Risk

need to decompose the risk...

- risk is mainly the error in estimating future mortality – the **TREND**
- affects all policies in force; the **LLN** does NOT work; **systemic & non-diversifiable**
- to handle risks like longevity require knowledge on **hedging**; **securitization**; etc.
- voluntary annuity schemes also have **self-selection**
- risk highlighted with **new table** – and significant reserve strengthening
- low **interest rate** environment also highlights longevity risks
- More sophisticated **capital modelling** required...nested stochastic runs



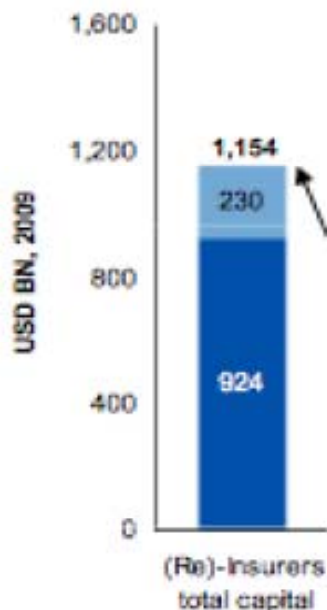
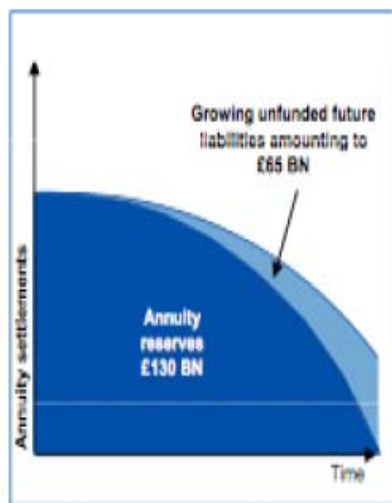
The Size of the LONGEVITY Problem...

it's a potentially BIG problem...

	Private Pension Liabilities	Life Insurance Industry	
	DB Liabilities	Annuity Reserves	Term Insurance Reserves
	US\$bn	US\$bn	US\$bn
US	6 000	100	150
UK	1 300	210	60
Total	7 300	310	210

Model	Immediate annuity payments Starting at age 65	
Females	% BE	
Best Estimate	23.61	
QIS 4: 75% BE	25.51	+ 8.0%
Lee Carter (LC)	25.01	+ 5.9%
Bayesian LC (BCL)	25.54	+ 8.2%
Cairns, Blake & Dowd (CBD)	26.79	+ 13.5%
Males		
Best Estimate	18.85	
QIS 4: 75% BE	21.09	+ 11.9%
LC $\log(q_{x,t}) = a_x + b_x \kappa_t + \text{error}$	20.00	+ 6.1%
BLC	20.71	+ 9.9%
CBD $\text{logit}(q_{x,t}) = \log\left(\frac{q_{x,t}}{1-q_{x,t}}\right) = \kappa_t^{(1)} + \kappa_t^{(2)}(x - \bar{x}) + \text{error}$	21.96	+16.5%

Under-reserving of certain risks could lead to a 50% increase in liabilities for UK life insurers...



Source: The Pensions Institute, Oliver Wyman analysis

Systemic Risk in Insurance
An analysis of insurance and financial stability
Special Report of The Geneva Association Systemic Risk Working Group



Risk Response

the basics...

Steer business	Avoid	Diversify	Mitigate or Hedge
<ul style="list-style-type: none"> • Long-term risk more threatening than short-term risks • Has to be reflected in steering business • Bonus and incentive system should be long-term 	<ul style="list-style-type: none"> • Product design: <ul style="list-style-type: none"> • Short term guarantees • Minimal guarantees • Include substantial margins and flexible profit participation • Optimal target groups 	<ul style="list-style-type: none"> • Mortality risks • Interest rate • Investments profiting from increasing longevity (e.g. nursing homes) 	<ul style="list-style-type: none"> • Suitable mortality portfolio • Longevity bonds or swaps • Reinsurance

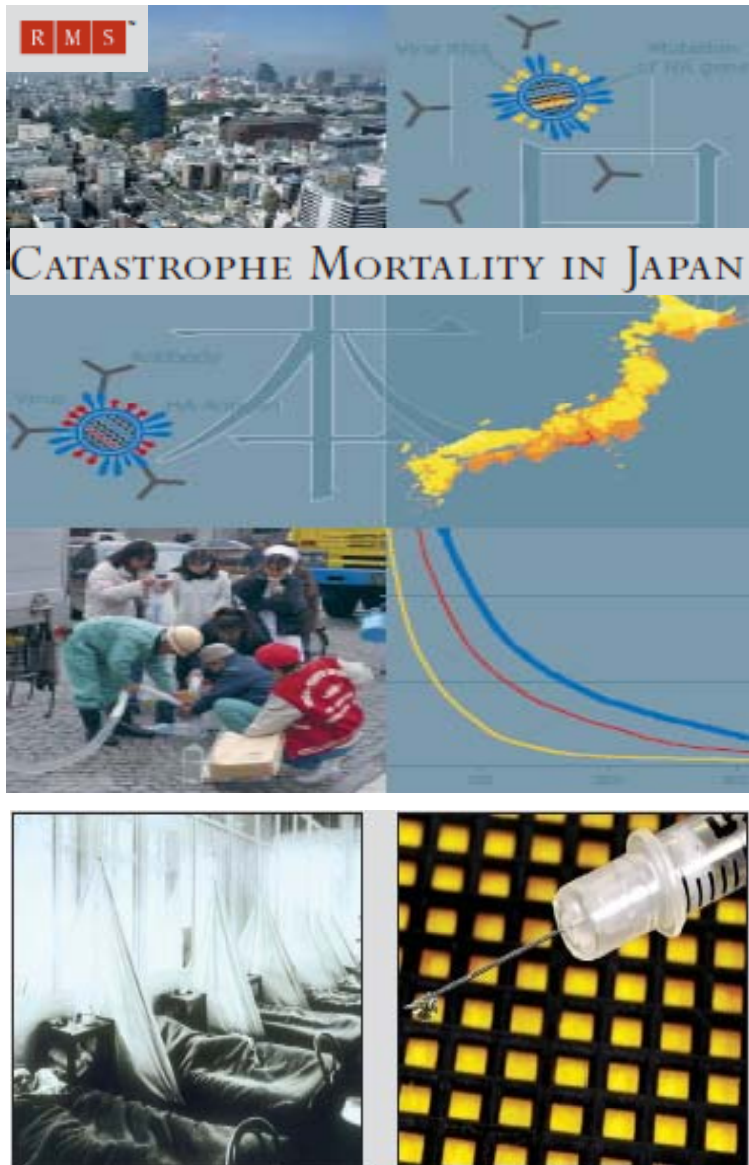


Reinventing Annuities



Is Mortality a Natural Hedge for Longevity ?

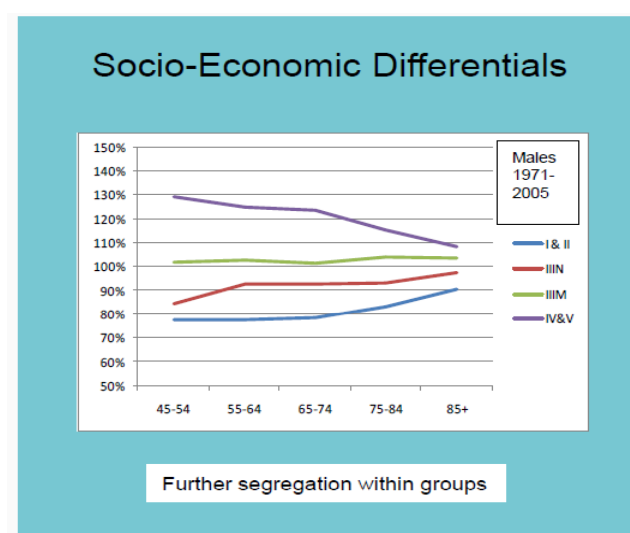
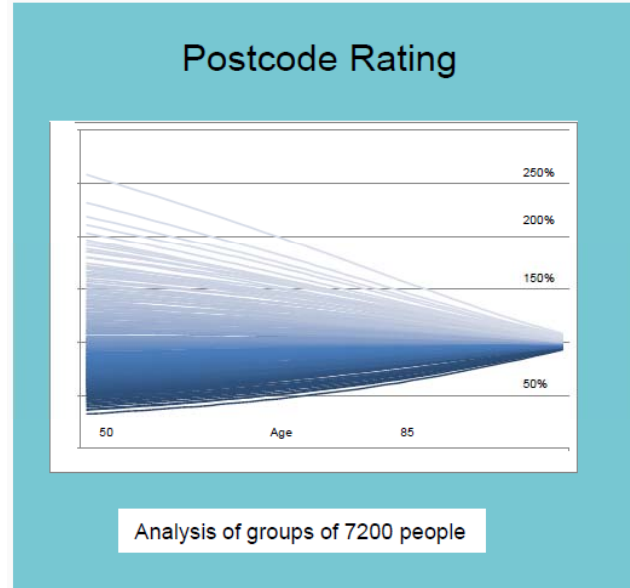
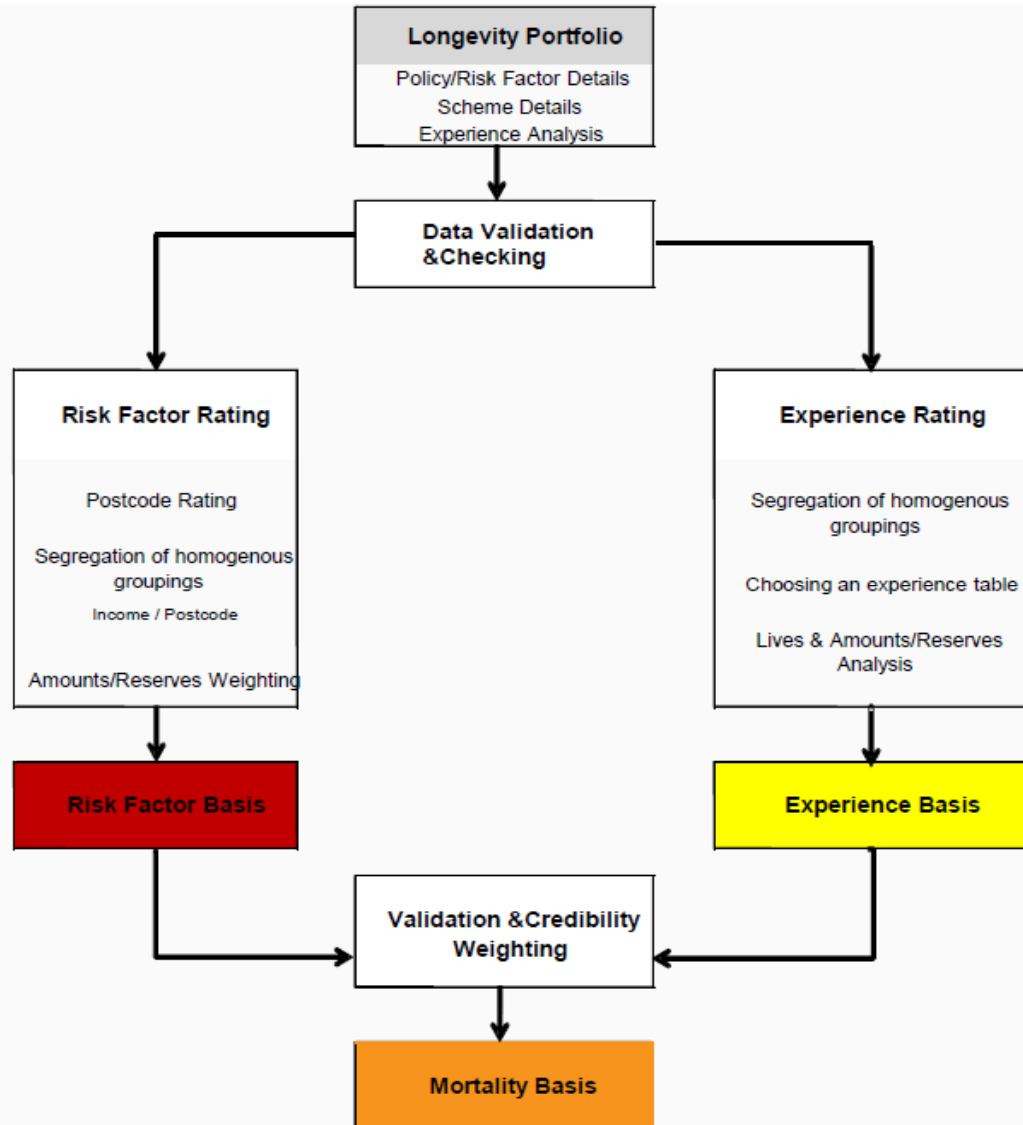
a complex issue...



- mortality should be a **natural hedge** for longevity
- however, impacts may apply to **different age** groups – young vs. old
- may be some benefit in internal capital models for **offsets** between catastrophic mortality risk (e.g. pandemics) & longevity – a diversification play
- diversification benefits also in **Solvency II**

Risk Factor Analysis

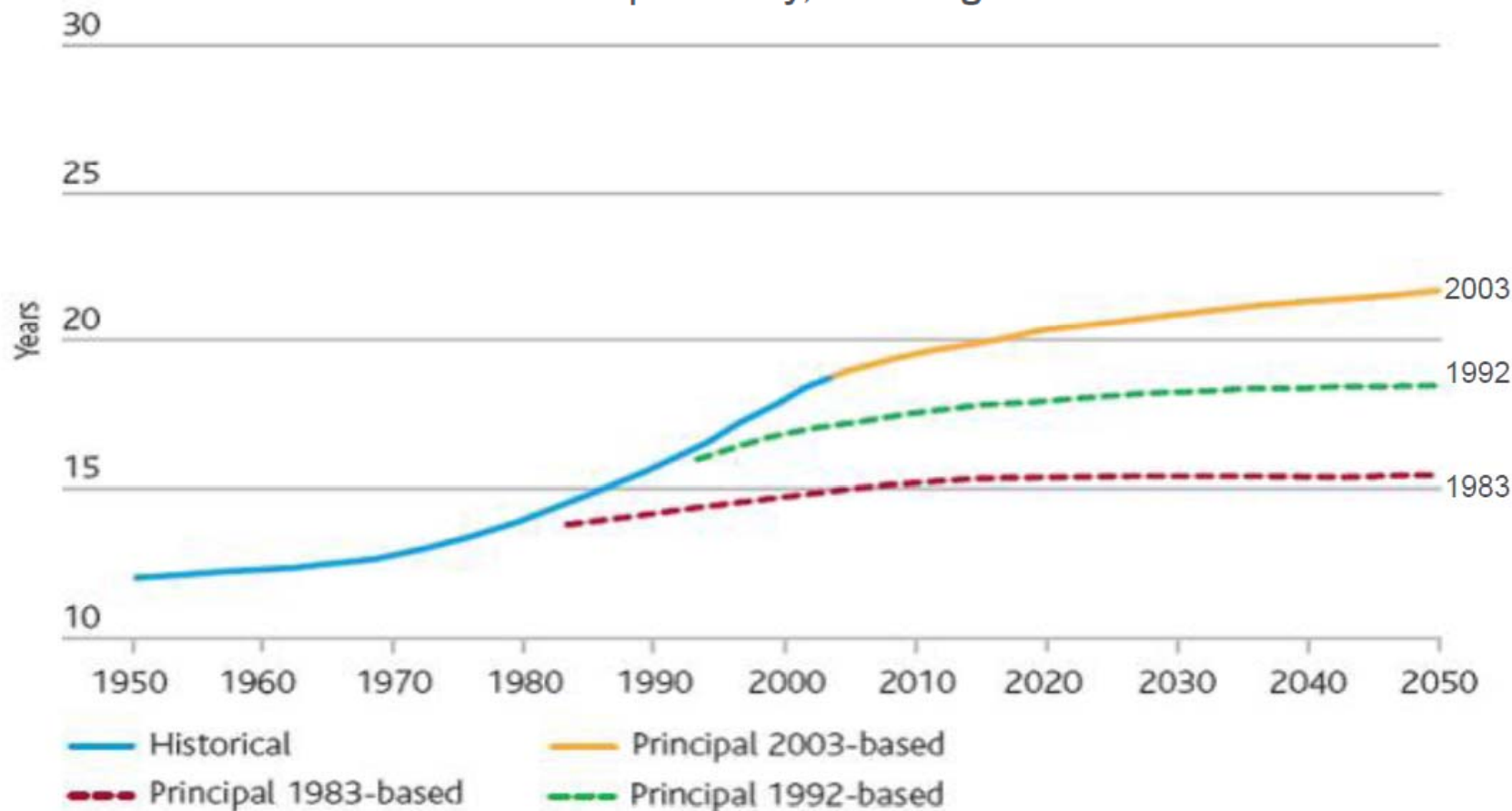
"individualized" mortality rates...



Past Record on Projecting Longevity

underestimation of longevity to date...

Life Expectancy, male age 65



Source: GAD, UK

Longevity & Medical Advances

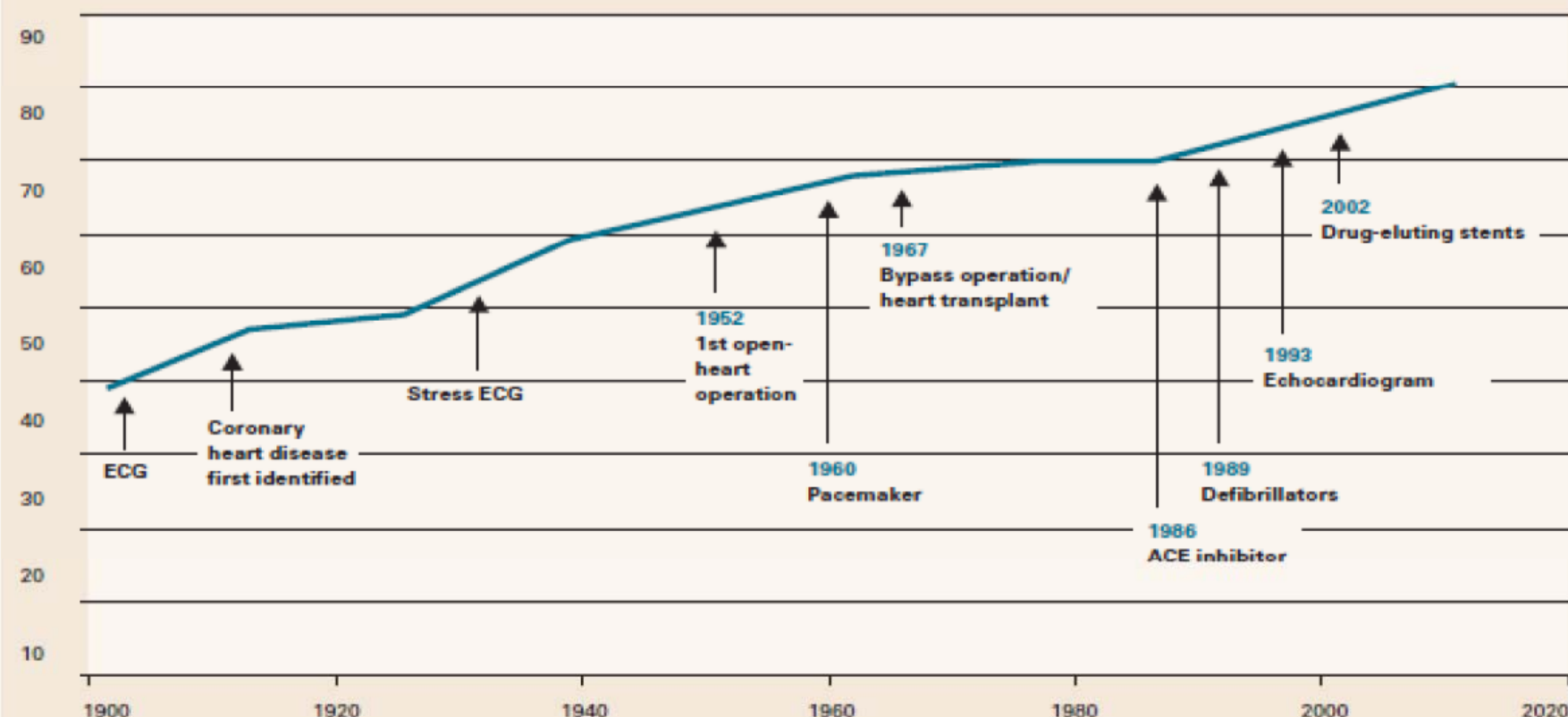
key driver of improved life expectancy...



Longevity and mortality

Coronary heart disease: an area of medical progress

Average life expectancy



Coronary heart disease (heart attack) in the light of medical progress in the last 100 years: female life expectancy in Germany increased from 40 years on average to just over 80 years.

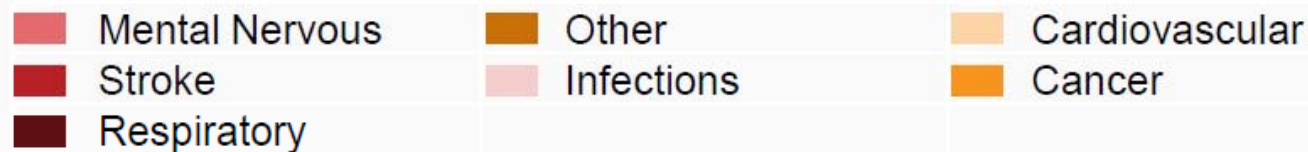
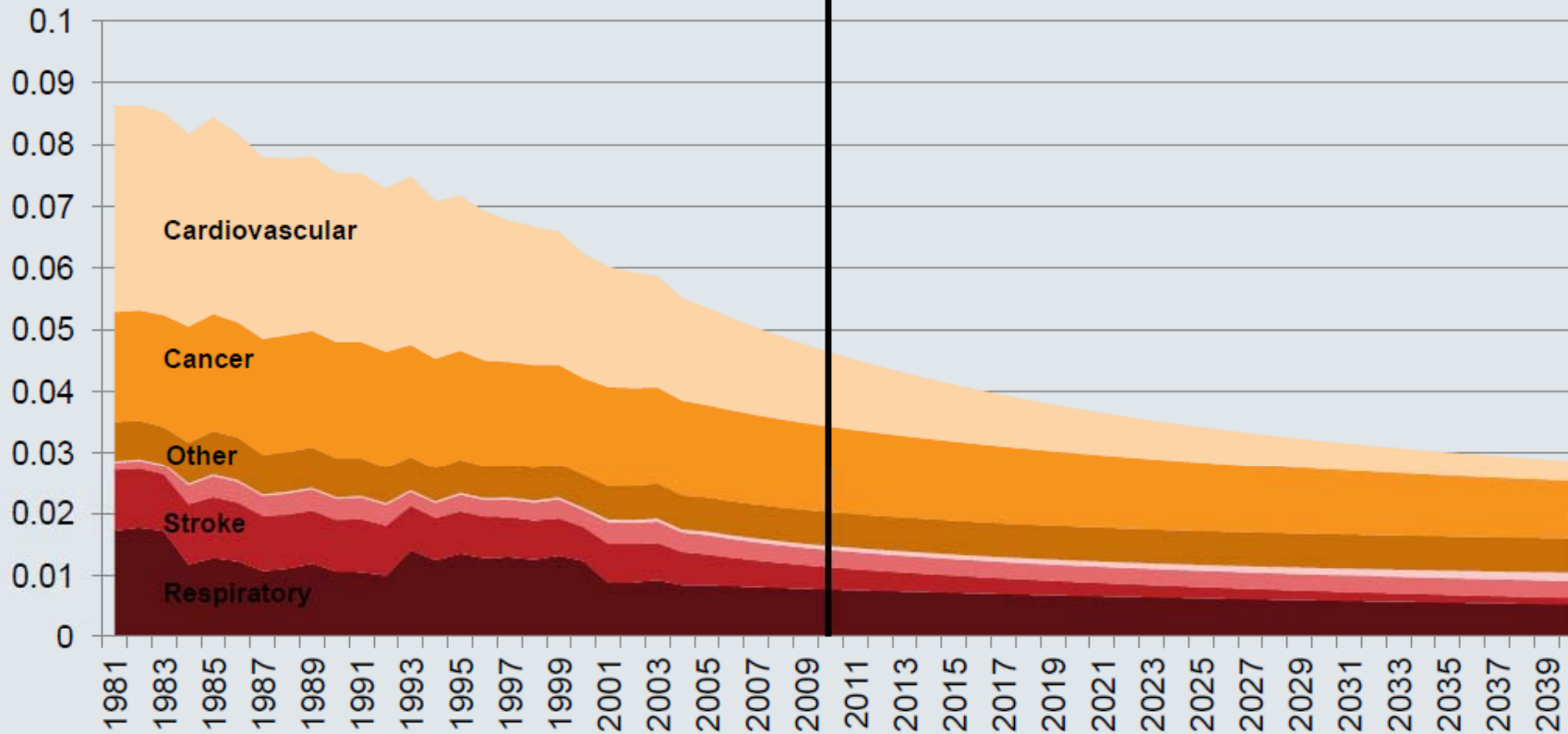
The graph also shows the most important milestones in the development of diagnostic and therapeutic possibilities for this disease.

Source: Munich Re

Longevity Risk Modelling

cause of death modelling – medical & actuarial input...

Mortality of typical male annuitant in payment portfolio



Trend Heat Map

captures experience of "Golden Cohorts"...



Projection For Males Lives Library 2: COD_ONS_Males_Long_Team

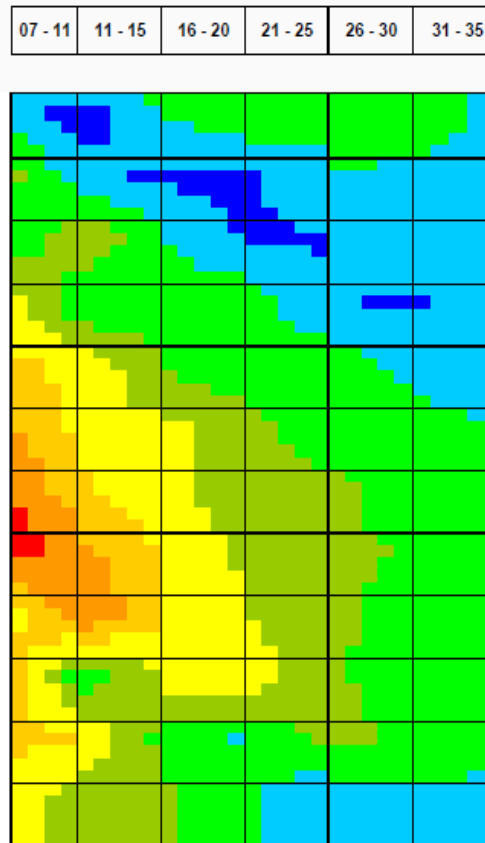
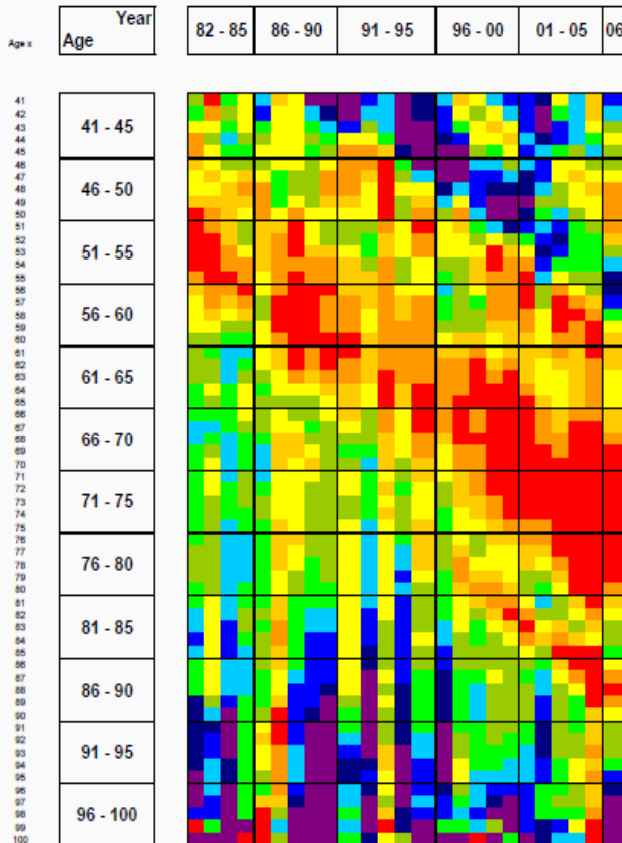
Lower Bound
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Set Palette:
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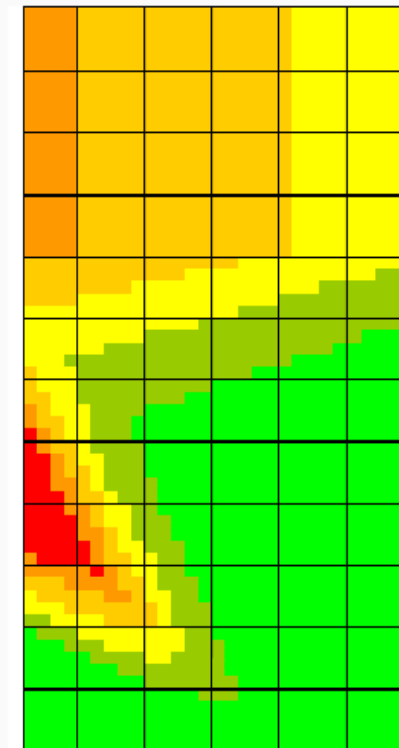
≥	-100%	-0.50%	0.00%	0.50%	1.00%	1.50%	2.00%	2.50%	3.00%	3.50%
<	-0.50%	0.00%	0.50%	1.00%	1.50%	2.00%	2.50%	3.00%	3.50%	100%
Colour	13	11	9	33	4	43	6	44	45	3

Historic Population Improvement Rates to Date

Projection Based on Library 2: COD_ONS_Males_Long_Team



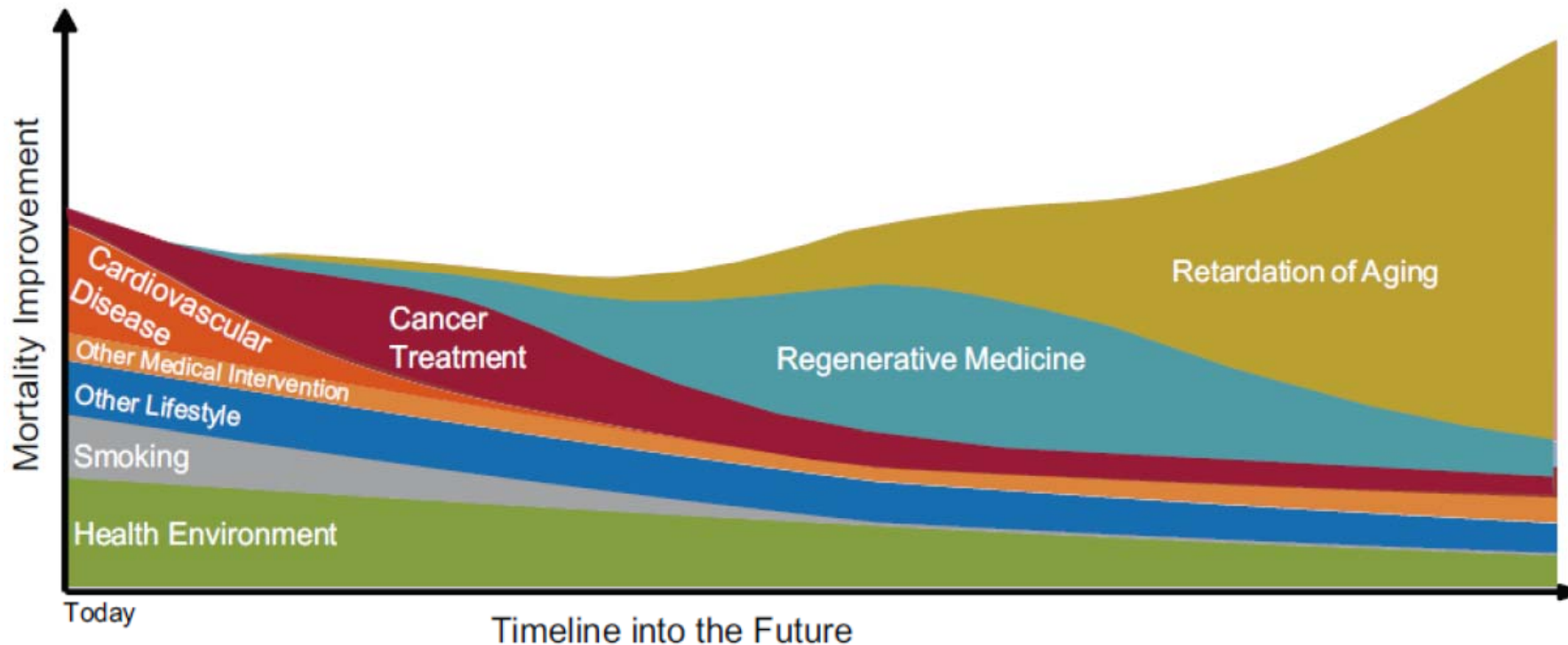
For comparison
Average Medium & Long Cohort with 1.25% floor



CoD Model captures cohort effect, but predicts reduced impact in future

Drivers of Mortality Improvements

what's next – Regenerative Medicine; Slowing of Aging...



Source: RMS

Need to understand the economic difference between RISK (knowable probabilities) vs. UNCERTAINTY (un knowable probabilities) .

“Bio-demographic Paradigm” of Mortality

who will be proved right ???



ICC Cricket World Cup
2011



Book: “*The Quest for Immortality*”

Age limit: 85

**Long Off –
Jay Olshansky**



Book: “*Ending Aging*”

Age limit: 500

**Long On –
Aubrey De Grey**



Challenges to Actuaries

Emerging Risks...Daring Solutions

Evolution of the Actuarial Profession...

The Evolution of the Actuary	Emergence	Description	Time to Emerge
Actuary of the 1st kind	17th century	life insurance actuaries using deterministic methods	
Actuary of the 2nd kind	20th century	casualty actuaries using probabilistic methods	250
Actuary of the 3rd kind	1980's	investment actuaries applying financial economics (Bühlmann)	70
Actuary of the 4th kind	current	actuaries working in ERM (Embrechts)	25

Source: Stephen P. D'Archy, CAS Presidential Address, 2005



The keys to understanding longevity risk lie in the future, not the past.

13th Global Conference of Actuaries 2011

Source: RMS

Complexity Science

An introduction (and invitation) for actuaries

Prepared by
Alan Mills FSA ND

Version 1
June 10, 2010

Actuaries
Risk is Opportunity[®]

February 20 – 22, 2011

Interesting Readings

Emerging Risks...Daring Solutions



Source: Time Magazine – 21 February 2011
February 20 – 22, 2011




THANK YOU VERY MUCH FOR YOUR ATTENTION

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References

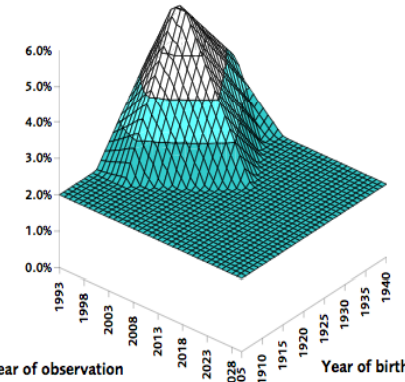
many – but here are a few good ones...



The Staple Inn Actuarial Society

Financial aspects of longevity risk

Stephen Richards
Gavin Jones



LONGEVITY IN THE 21ST CENTURY

By R. C. WILLETS, A. P. GALLOP, P. A. LEANDRO, J. L. C. LU, A. S. MACDONALD, K. A. MILLER, S. J. RICHARDS, N. ROBJOHNS, J. P. RYAN AND H. R. WATERS

[Presented to the Faculty of Actuaries, 15 March 2004, and to the Institute of Actuaries, 26 April 2004]



**Coping with Longevity:
The New German Annuity Valuation Table DAV 2004 R**

Ulrich Pasdika Jürgen Wolff
Gen Re and MARC Life
Cologne, Germany Atlanta, Georgia

Presented at The Living to 100 and Beyond Symposium
Sponsored by the Society of Actuaries

Orlando, Fla.

January 12-14, 2005


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Society of Actuaries

**2000-04 Individual Payout
Annuity Experience Report**

April 2009



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Fax: 847-706-3599
Website: <http://www.soa.org>

**Post-Retirement Financial Strategies from the Perspective of
an Individual Who Is Approaching Retirement Age**

Sponsored by
Society of Actuaries' Pension Section

Prepared By
Arnold F. Shapiro
Smeal College of Business
Penn State University
August 2010

