Innovations in product design to manage longevity and long-term care risks

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Agenda

- Introduction & motivation

- Life annuities

- Long-term care insurance products

- Health-linked life annuities

- Concluding remarks

INTRODUCTION & MOTIVATION

In current scenarios, many "traditional" products in the field of life & health insurance:

- do not fit the individual needs
- imply severe risks for insurance companies (and pension funds)
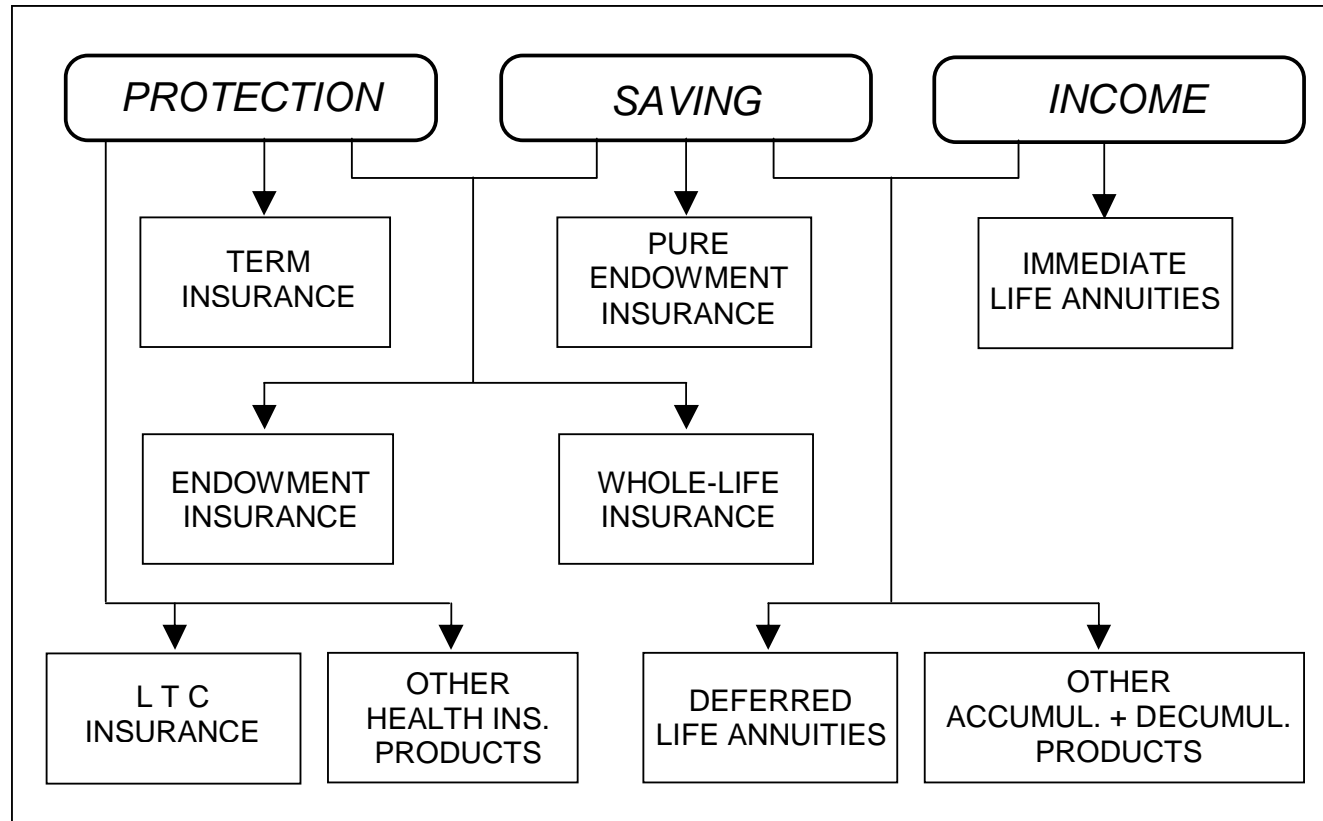
(see following Figure)

Significant individual needs:

- ▷ post-retirement income (individual longevity risk))
- ▷ health-related protection, in particular at old and very old ages (expense risk and individual longevity risk)

Risks borne by the insurer:

- aggregate longevity risk
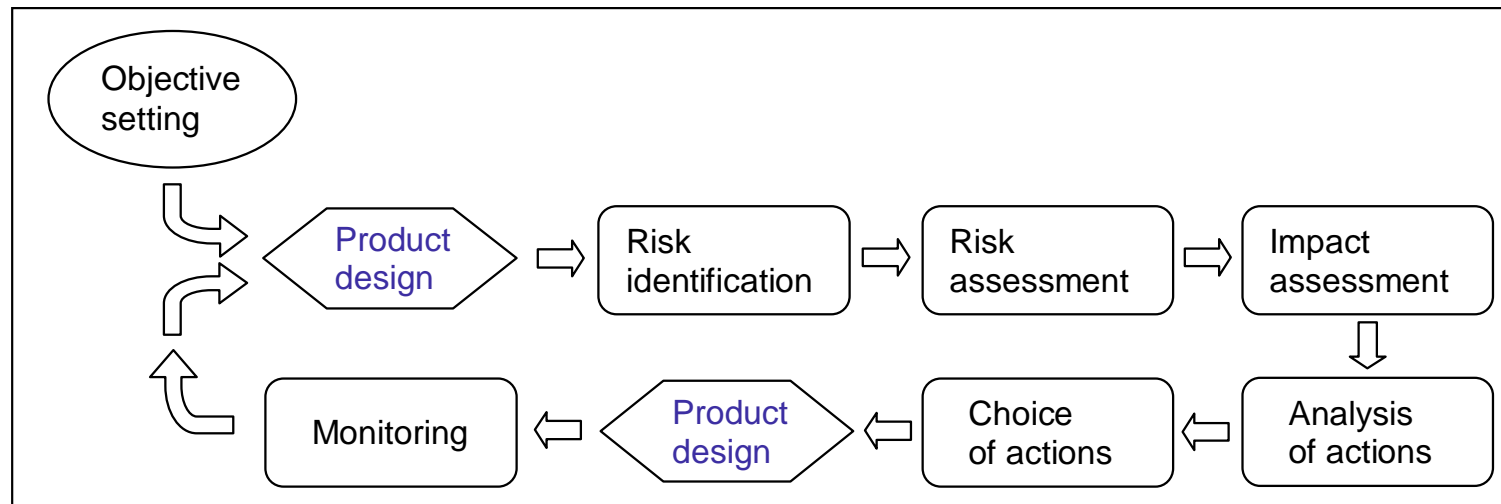- pricing and reserving risks due to poor statistical experience

Life and health insurance products: classification according to purposes (1)

Enterprise Risk Management (ERM) can suggest appropriate solutions

In particular, product design should be considered a critical phase in the Risk Management (RM) process $\Rightarrow$ product innovation

Product design as a phase of the RM process

Looking at recent trends

1. Life annuities:

    (a) from "investment" to longevity insurance $\Rightarrow$ old-age life annuities

    (b) extension of the rating principles $\Rightarrow$ "special-rate", or "underwritten", life annuities

2. LTCI: from stand-alone to combo products, e.g. including lifetime-related benefits

Note that:

- Approach 1(a) $\Rightarrow$ restriction of the coverage

- Approach (2) $\Rightarrow$ extension of the coverage

- Approaches 1(b) and (2) $\Rightarrow$ possible implementation via health-linked life annuities

All the above trends should carefully be analyzed, also to capture new opportunities in product design

Aim of this presentation: to provide some guidelines, hopefully useful in exploring the broad (and evolving) range of innovative products
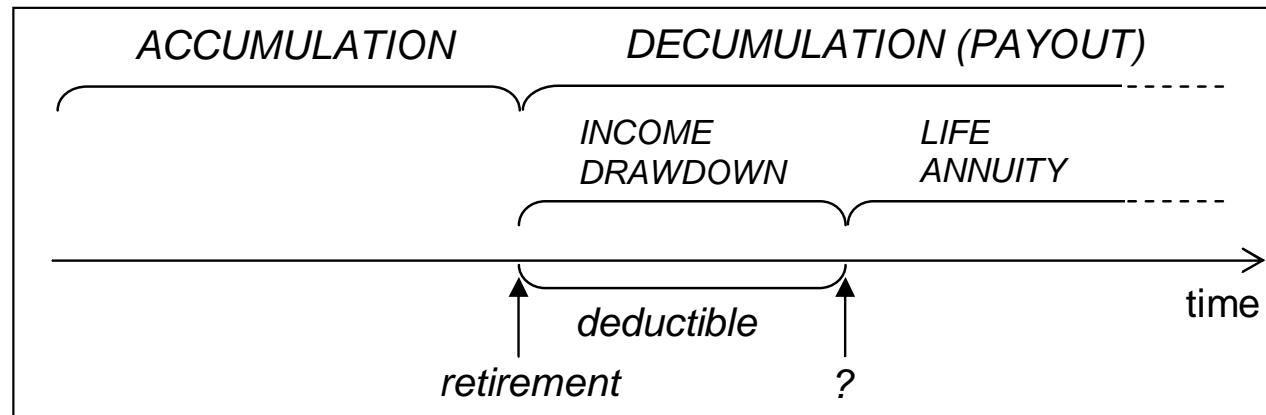
LIFE ANNUITIES

THE FIVE "W"

What ?

The key question: what is a life annuity

Possible answers:

- an *investment*, but
  - ▷ illiquid asset $\Rightarrow$ a strange investment ?

- an *insurance* against the longevity risk (possible exhaustion of the resources)
  - ▷ in any insurance contract we can introduce a *deductible*
  - ▷ in a life annuity contract, the deductible can consist in a period throughout which the post-retirement income is obtained by drawdown (see following Figure)

Assume the life annuity as an insurance with a deductible

Then, two problems:

1. what is the (appropriate) length of the deductible period

2. when is the life annuity purchased

   (a) at the end of the deductible period

   (b) prior to retirement or at retirement $\Rightarrow$ an old-age deferred life annuity

Hints and comments

1. The deductible period should cover an age range for which the probability of survival is very high (say, up to age 80) $\Rightarrow$ the life annuity really covers the individual longevity risk (the tail of the lifetime probability distribution)

2. As regards the purchase time:

    (a) the technical basis is the one current at the end of the deductible period $\Rightarrow$ the retiree is exposed to the risk of unfavorable technical basis, because of
     ▷ higher life expectancy
     ▷ lower interest rate
     in the assumptions

    (b) the technical basis is stated in advance and hence guaranteed (see the ALDA product)

Why ?

The retiree's perspective

Main purpose of the life annuity: to obtain a post-retirement income

Lifelong income $\Rightarrow$ hedge against the (individual) longevity risk, that is, risk of outliving assets available at retirement

The insurer's perspective

Longevity guarantee provided by the insurer: to pay the stated benefit

    ▷ whatever the individual lifetime (*individual* longevity risk
       $\Rightarrow$ *idiosyncratic* risk)

    ▷ whatever the lifetimes in the annuity portfolio (*aggregate* longevity
       risk $\Rightarrow$ *systematic* risk)

When ?

The retiree's perspective

"To annuitize or not to annuitize": a wrong question, if looking for protection against the individual longevity risk

"When (and how much) to annuitize": a reasonable question

Looking at the lifetime probability distribution:

- high probability of being alive at old ages (say 80, 85, ...)
- significant tail

Reasonable choices, consistent with the lifetime distribution: see answer to the *"What?"* question

The insurer's perspective

What about the (individual and aggregate) longevity risk taken by the annuity provider ?

Old-age life annuity $\Rightarrow$ smaller premium (according to the equivalence principle), but *tail risk*

Who ?

Common situation, due to strong self-selection effect: only people in very good health conditions purchase a (standard) life annuity

Result:

- size of the annuity portfolio small w.r.t. the number of potential clients (propensity to annuitize should also be considered)
- probably, very low degree of (unobservable) heterogeneity

How to enlarge the portfolio of potential annuitants ?

Where ?

Where the retiree lives $\Rightarrow$ *Postcode* life annuities, i.e. life annuity rates depending on socio-geographic conditions

> ▷ What about the impact on mortality of the above conditions?

> ▷ Is the postcode a good proxy ?

Remark

> ***Who & Where*** $\Rightarrow$ annuity rates tailored on individual characteristics
> $\Rightarrow$ more *risk factors* allowed for as *rating factors* (but in European Union gender is not allowed as a rating factor !)

See Pitacco [2016a, 2017], and references therein

LONGEVITY INSURANCE ANNUITIES

Advanced Life Delayed Annuity (ALDA)

The premium payment period does not necessarily coincide with the (traditional) accumulation phase, being possibly shifted towards older ages

The payout period starts after retirement time (age 80 or 85, say)

$\Rightarrow$ withdrawal from a fund throughout the time interval following the retirement time to get post-retirement income

Purposes of ALDA:

- to provide longevity insurance at old ages only (that is, *insurance cover with a deductible*)
- to reduce premium amount (with respect to conventional deferred annuities)
- to enhance rates of voluntary annuitization

Ruin Contingent Life Annuity (RCLA)

The post-retirement income is provided by:

(1) withdrawal from a fund from time r onwards, up to (possible) exhaustion of the fund

(2) a life annuity paid to the retiree from (random) time T of fund exhaustion because of "adverse" scenario

> ▷ poor performance of the fund
> ▷ long lifetime

RCLA can be thought as:

(a) an ALDA with random delay, and trigger given by the scenario

(b) an insurance product generating annuitization as a worst case scenario

Pricing RCLA $\Rightarrow$ need for constructing a pseudo-index, accounting for

- the behaviour of a market performance index
- a set of reasonable withdrawal rates throughout the payout phase

▷ ALDA proposed by: M. A. Milevsky. Real longevity insurance with a deductible: Introduction to advanced-life delayed annuities (ALDA). *North American Actuarial Journal*, 9:109–122, 2005

▷ RCLA proposed by: H. Huang, M. A. Milevsky, and T.S. Salisbury. A different perspective on retirement income sustainability: The blueprint for a ruin contingent life annuity (RCLA). *Journal of Wealth Management*, 11(4):89–96, 2009

LONG-TERM CARE INSURANCE PRODUCTS

TLE AND HLE DYNAMICS

In all lifelong living benefits (i.e. life annuities, lifelong sickness insurance covers, long-term care annuities, etc.) the insurer bears the longevity risk, and in particular its systematic component, i.e. the aggregate longevity risk

In the case of health insurance products, e.g. long-term care annuities, risk further emerges from uncertainty concerning the time spent in the disability state

Three main theories proposed about the evolution of senescent disability (see following Figure)

Most important features of the three theories expressed in terms of the evolution of *total life expectancy* (TLE) and *healthy life expectancy* (HLE) (or DFLE = disability-free life expectancy)

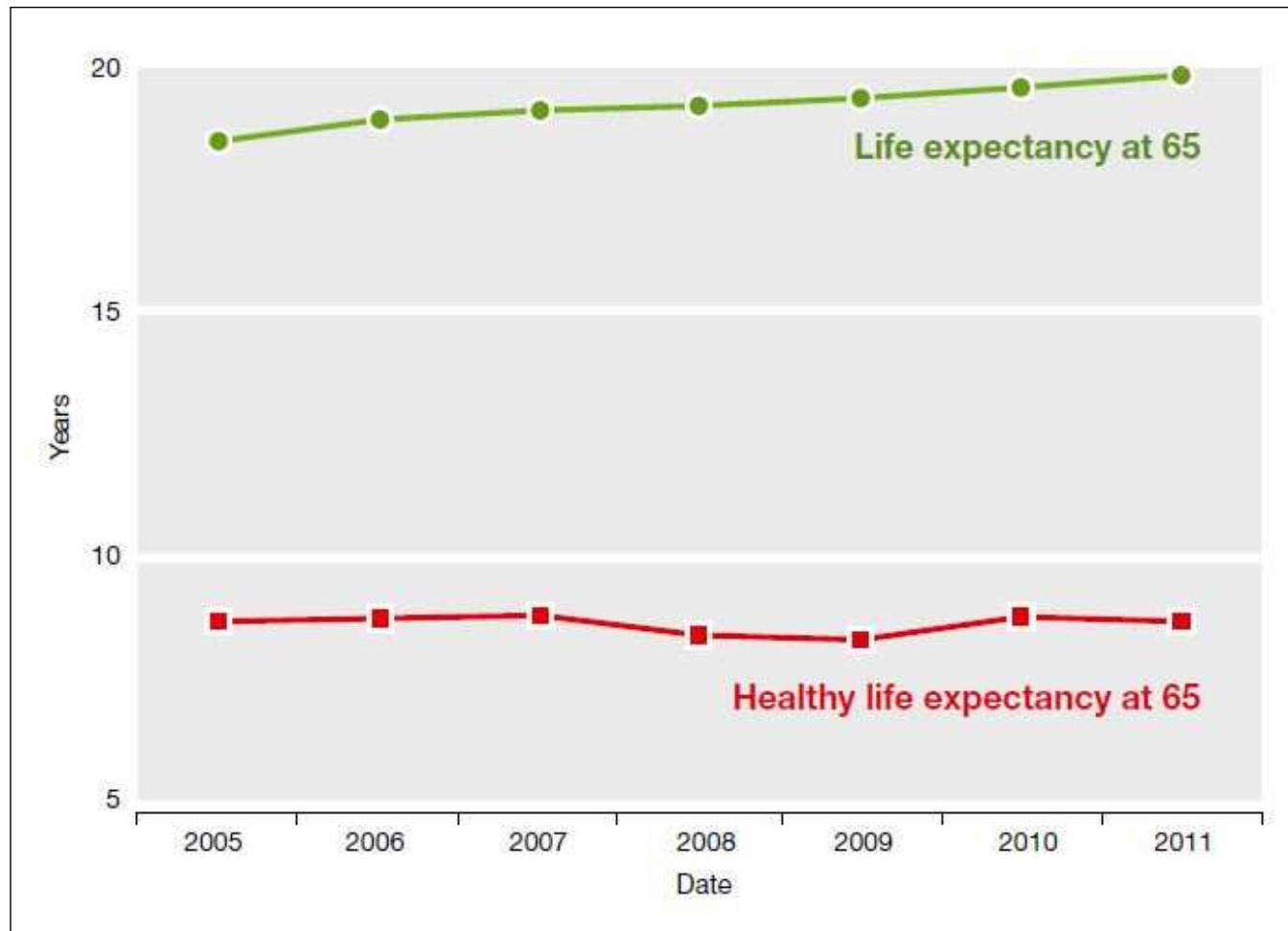| (a) Compression theory | (b) Equilibrium theory | (c) Pandemic theory |
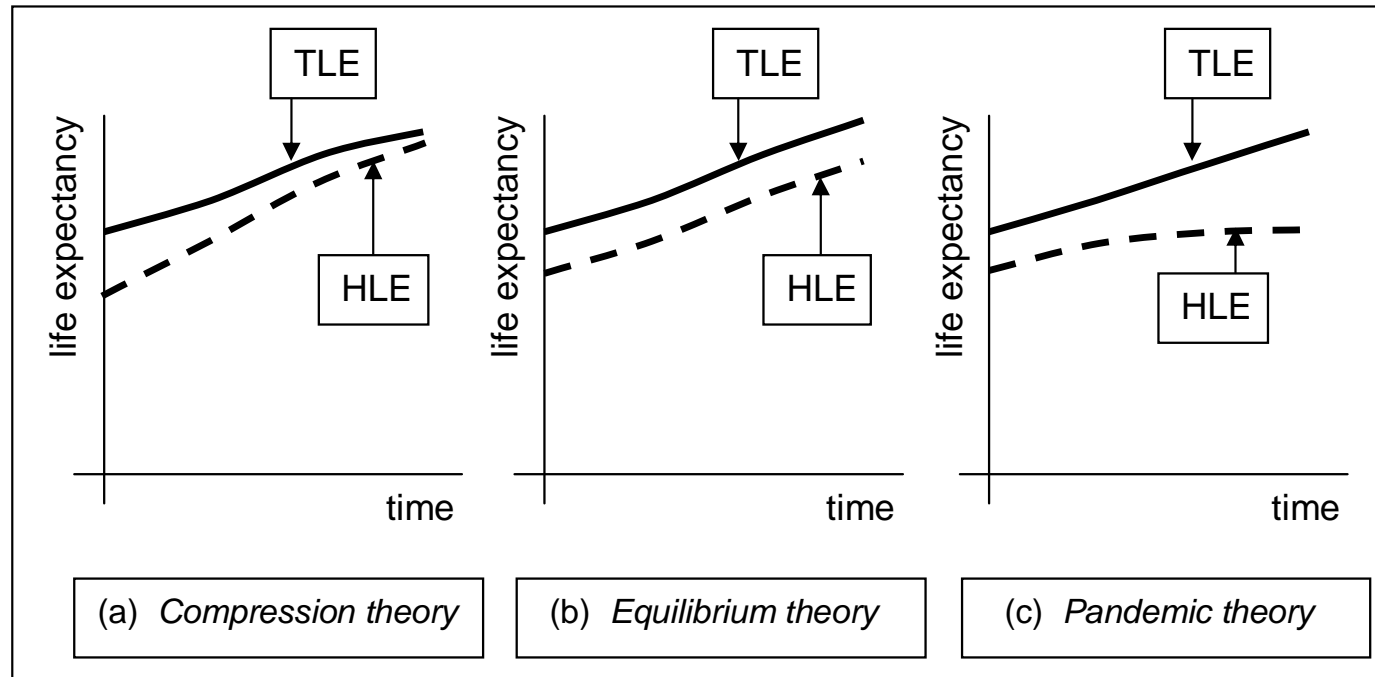
TLE and HLE: projected trends according to different theories

Observed average trend in 25 EU countries $\Rightarrow$ TLE increasing, but HLE approx constant over recent years

See following figure

ASTIN Non-Life Insurance

AFIR-ERM Finance, Investment & ERM

Average life expectancy and healthy life expectancy at age 65 in 25 EU countries
(Source: G.C. Brown, Living too long, EMBO Reports, 16(2), 2015)

LONG-TERM CARE INSURANCE (LTCI)

LTCI products provide the insured with financial support, while he/she needs nursing and/or medical care because of chronic (or long-lasting) conditions or ailments ($\Rightarrow$ implying dependence)

Remark

Interest in analyzing LTCI products:

▷ In many countries, elderly population rapidly growing because of increasing life expectancy and low fertility rates

▷ Household size is progressively reducing $\Rightarrow$ lack of assistance and care services provided to old family members of the family

▷ LTCI products are rather recent $\Rightarrow$ senescent disability data are scanty $\Rightarrow$ pricing difficulties

▷ High premiums (viz because of a significant safety loading) $\Rightarrow$ obstacle to the diffusion of these products

▷ Stand-alone LTCI product: only "protection" $\Rightarrow$ packaging of LTCI benefits with lifetime-related benefits can enhance propensity to LTCI

LTCI products: a classification

- Benefits with *pre-defined amount* (usually, a lifelong annuity benefit); in particular:
  - ▷ *fixed-amount* benefit
  - ▷ *degree-related* (or *graded*) benefit, i.e. graded according to the severity of the disability itself
- Reimbursement (usually partial) of nursery and medical expenses, i.e. *expense-related* benefits
- *Care service* benefits; for example provided in the US by Continuous Care Retirement Communities (CCRCs)

Focus on pre-defined benefits

Long-term care insurance products *(cont'd)*
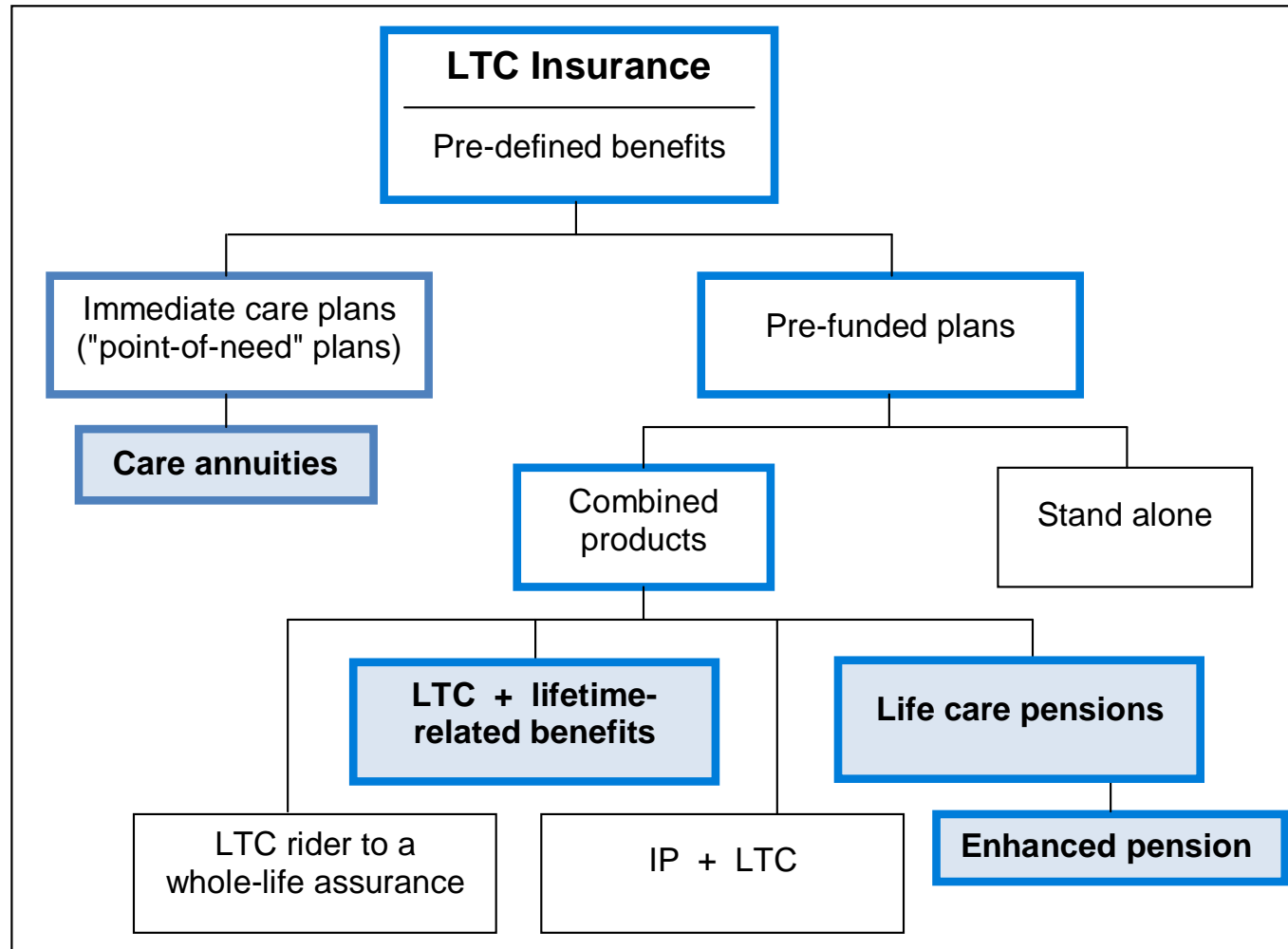
A classification of LTCI products providing pre-defined benefits

Care Annuity

A particular type of single-premium underwritten (or "special-rate") life annuity

Care annuities are aimed at individuals with very serious impairments, or individuals who are already in a senescent-disability (or long-term care) state

See also: *Health-linked life annuities*

See: Brown and Warshawsky [2013], Murtaugh et al. [2001], Pitacco [2014], Warshawsky [2007], Zhou-Richter and Gründl [2011]

HEALTH-LINKED LIFE ANNUITIES

Outlook

In the area of life & health insurance products

- immediate standard life annuities, and
- stand-alone LTCI products

implement two "extreme" product designs, both with significant difficulties, from the client's as well as the insurer's perspective:

- ▷ life annuities: the "annuity puzzle" !
- ▷ stand alone LTCI: high premium for a "pure protection" product

Looking at a classification of insurance products in the life & health area (see following Figure), we can:

- realize that some interesting products ("combo" products, already existing) are not captured by the previous scheme (see *Introduction & motivation*)
- develop new combo product designs by generalizing some features

Health-linked life annuities *(cont'd)*
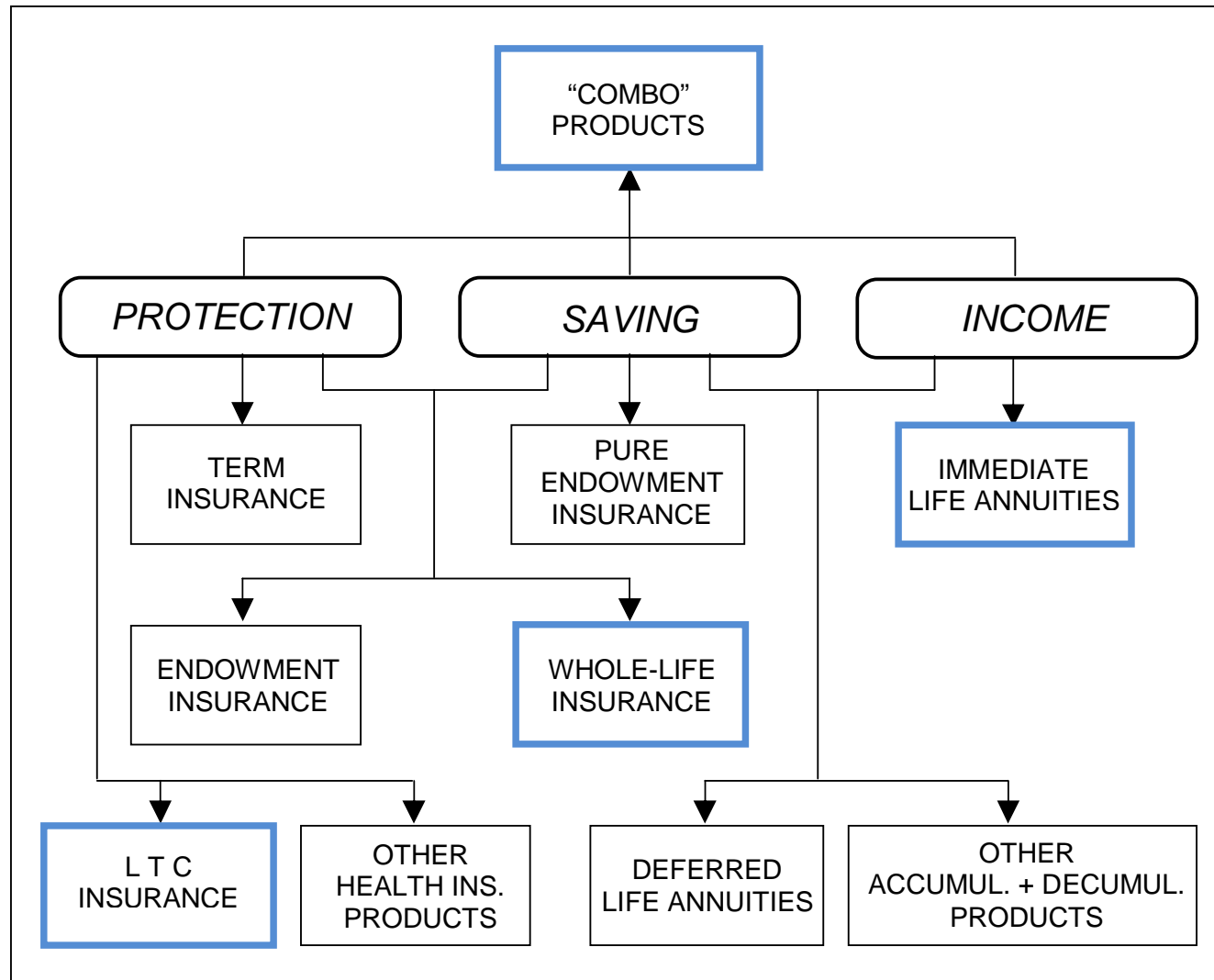
Life and health insurance products: classification according to purposes (2)

A GENERAL FRAMEWORK

Our target:

- to recognize existing products and analyze their relevant features
- to provide hints for (possible) new products

Basic feature of a health-linked life annuity: for a given (single) premium, the benefit amount $B(t)$ (either constant or varying throughout the policy duration) depends on the annuitant's health status (either at policy issue or throughout his/her lifetime)

In formal terms, the annuitant's health status can be represented by a stochastic process

$$\{H(t); t \geq 0\}$$

to be defined in terms of:

- $\triangleright$ values (e.g. in LTCI via ADL's or IADL's scoring)
- $\triangleright$ probabilistic structure (e.g. Markov or semi-Markov)

Insurance products: examples

Standard life annuity (flat profile)

$$B(t) = B = \frac{\Pi}{\ddot{a}_x} = f(\Pi); \quad t = 1, 2, \ldots$$

where Π = single premium

Health status not explicitly considered, but assumed very good
($\Rightarrow$ annuitants' self-selection)

Annuities with static health-linking

$$B(t) = B = \phi(\Pi, H(0)); \quad t = 1, 2, \ldots$$

Example: underwritten, "special-rate", life annuity (flat profile)

The health status at policy issue is accounted for via underwriting

Purpose:

$$\phi(\Pi, H(0)) > f(\Pi)$$

$\Rightarrow$ better annuity rate, in case of non-optimal health conditions

See the following

Annuities with dynamic health-linking

$$B(t) = \psi(\Pi, H(t)); \;\; t = 1, 2, \ldots$$

Several examples, with related definitions of the health status

- LTC annuities
  - ▷ stand-alone and combo products
- Disability annuities (e.g. Income Protection)
  - ▷ possibly degree-related
- ……

See the following

"SPECIAL-RATE" LIFE ANNUITIES

Approaches to underwriting

"Special-rate" life annuities also called *underwritten annuities*
$\Rightarrow$ mortality higher than the standard one, assessed via the
underwriting process

Focus on:

(1) what risk factors can be chosen as rating factors, besides annuitant's age (and gender, if permitted by the local current legislation)

(2) how many rating factors are actually accounted for in the underwriting process of a given special-rate annuity

(3) how many rating classes, that is, how many different annuity rates, are defined

As regards (1), higher mortality can in particular be due to the following causes:

(1a) Applicant's *health*, and in particular presence of some past or current *disease*

(1b) Applicant's *lifestyle* (e.g. smoking and drinking habits, sedentary life, etc.)

(1c) *Environment* in which the applicant lives $\Rightarrow$ socio - geographical risk factors

Note that:

▷ higher number of rating factors (see point (2)) $\Rightarrow$ more complex underwriting process

▷ higher number of rating classes (see point (3)) $\Rightarrow$ better fitting of the individual risk profile

Number of rating classes $\Rightarrow$ alternative pricing schemes

(3a) *Single-class* underwriting scheme: one or just a few rating factors are used $\Rightarrow$ underwriting results in a yes/no answer; if yes, a given annuity rate, higher than the "standard" one, is applied; examples:

  ▷ marital status

  ▷ smoking habits

(3b) *Multi-class* underwriting schemes can be implemented either considering just one rating factor with several possible values, or more rating factors

(3c) *Individual underwriting* allows to use all available information about the individual $\Rightarrow$ annuity rate tailored on the applicant's characteristics

See following Figure
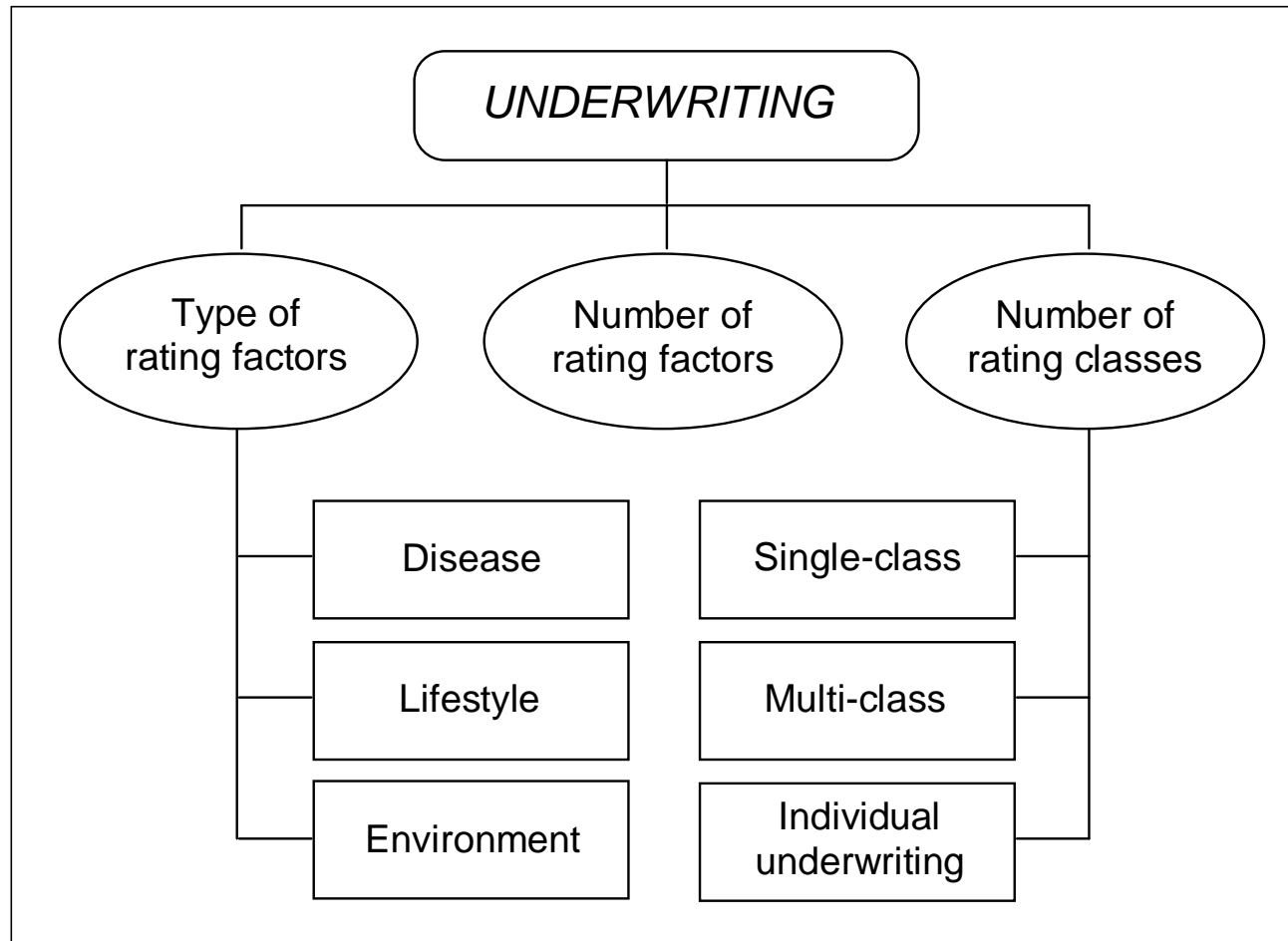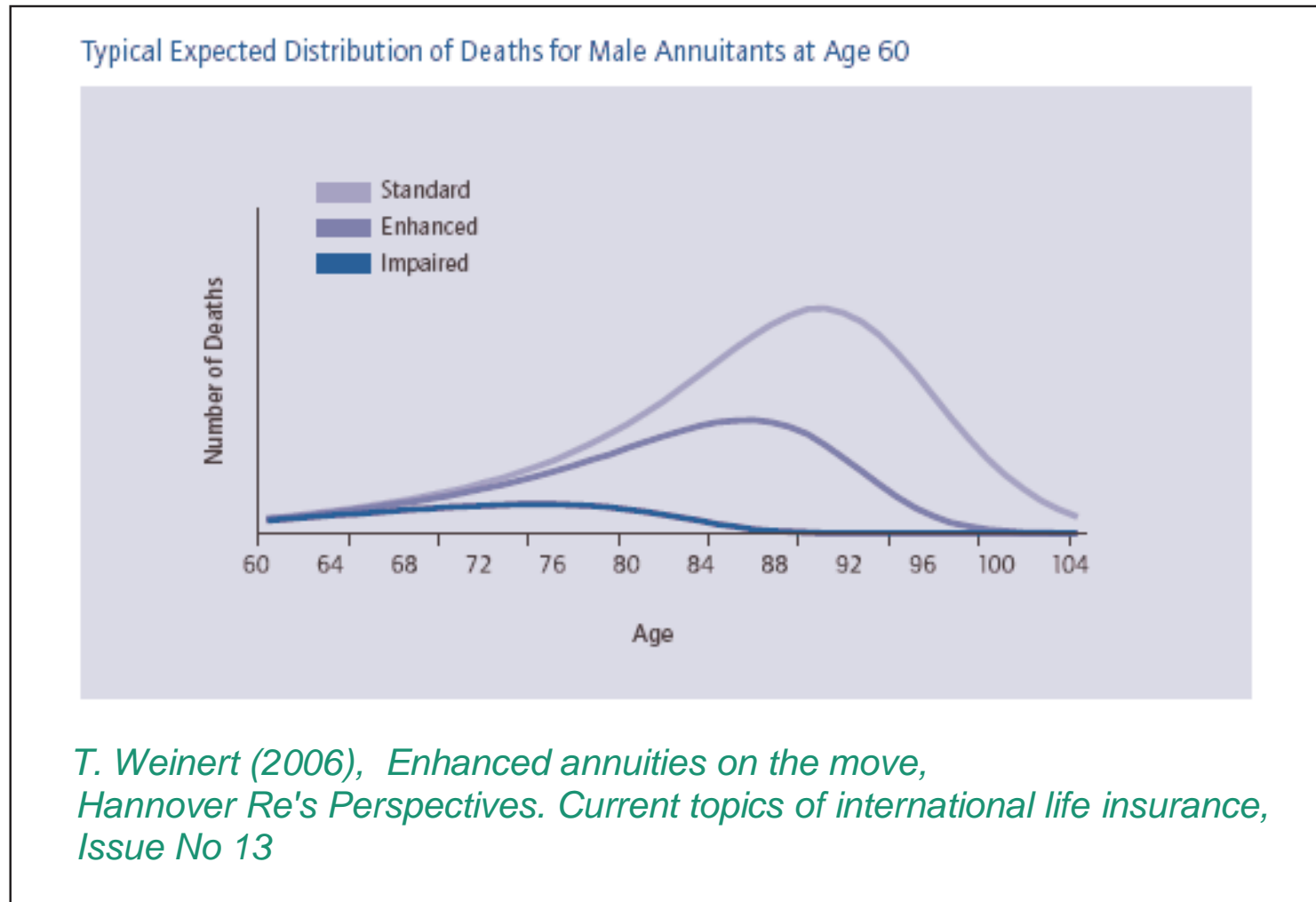
Special-rate life annuities: underwriting criteria

Examples

Applicant's *health status* is considered in the following special-rate annuities

- *Enhanced life annuity* pays out an income to a person with a slightly reduced life expectancy, in particular because of a personal history of medical conditions

- *Impaired-life annuity* pays out a higher income than an enhanced life annuity, as a result of medical conditions which significantly shorten the annuitant's life expectancy (e.g. diabetes, chronic asthma, cancer, etc.)

- *Care annuities* are aimed at individuals with very serious impairments, or individuals who are already in a senescent-disability (or long-term care) state; see also *Life annuity products providing LTC benefits*

Various factors concerning the health status can be accounted for
$\Rightarrow$ usually, multi-class underwriting

Health-linked life annuities *(cont'd)*

Typical Expected Distribution of Deaths for Male Annuitants at Age 60

T. Weinert (2006), Enhanced annuities on the move, Hannover Re's Perspectives. Current topics of international life insurance, Issue No 13

Lifestyle annuities can take into account one or more rating factors, and can result in a single-class or a multi-class underwriting

Examples of lifestyle annuities:

- *Smoker annuities*: if the applicant has smoked at least a given number of cigarettes for a certain number of years, he/she is eligible for smoker annuities; single-class underwriting is implemented

- *Unmarried lives annuities*: higher mortality rates of unmarried lives $\Rightarrow$ higher annuity rate; single-class underwriting is implemented

Postcode life annuities: postcode as a proxy for social class and location of housing, i.e. risk factors which have impact on the life expectancy $\Rightarrow$ important example of environment-based rating; multi-class underwriting is implemented

See: Ainslie [2000], Drinkwater et al. [2006], Edwards [2008],
Gatzert et al. [2012], Hoermann and Russ [2008],
Meyricke and Sherris [2013], Ridsdale [2012]. Rinke [2002]

LTC ANNUITIES:
FROM STAND-ALONE TO COMBO PRODUCTS

Stand-alone LTC degree-related annuity

$$B(t) = \begin{cases} 0 & \text{if } H(t) = \text{good} \\ b^{(1)} & \text{if } H(t) = \text{bad} \\ b^{(2)} & \text{if } H(t) = \text{very bad} \end{cases}$$

Health status expressed in terms of ADL's or IADL's

Problem: high sensitivity of actuarial values (premiums and reserves) w.r.t. biometric assumptions (disablement, possible recovery, mortality of disabled people)

Enhanced pension (or life care pension)

$$B(t) = \begin{cases} b' & \text{if } H(t) = \text{good} \\ b'' & \text{if } H(t) = \text{bad} \end{cases}$$

The uplift $b'' - b'$ can be financed by a reduction w.r.t. the basic pension

Advantage: lower sensitivity w.r.t. biometric assumptions

LTC annuity combined with old-age life annuity

$$B(t) = \begin{cases} b & \text{if } H(t) = \text{good} \wedge (t \geq t^*) \\ b' & \text{if } H(t) = \text{bad} \end{cases}$$

with e.g. $t^* = 80$

An example of combo product, providing longevity insurance $\Rightarrow$ LTCI combined with ALDA

The disability state is assumed permanent $\Rightarrow$ the two benefits are mutually exclusive

A death benefit can be added ($\Rightarrow$ bequest motivation)

SOME TECHNICAL ISSUES

Underwritten life annuities

In Olivieri and Pitacco [2016]:

- Portfolio consisting of standard annuities and underwritten annuities

- Larger size $\Rightarrow$ contributes to lower variance in portfolio results (as regards the idiosyncratic risk, i.e. risk of random fluctuations)

- Heterogeneity in the combined portfolio $\Rightarrow$ might contribute to raise variance in portfolio results

  ▷ heterogeneity among sub-portfolios

  ▷ some degree of residual heterogeneity inside each sub-portfolio, because of residual unobservable risk factors (the underwriting process only provides a proxy)

- What about the "balance"?

- Numerical examples show that appropriate rating classes can improve the portfolio risk profile

LTCI: stand-alone vs combo products

In Pitacco [2016b]:

- Different LTCI products

- Sensitivity w.r.t. to technical basis (probability of entering the LTC status, mortality of LTC people)

- Highest sensitivity of the stand-alone, lower sensitivity of all the combo products (in particular, the whole-life assurance with LTCI as acceleration benefit)

CONCLUDING REMARKS

When developing a new product:

- What benefit structure, e.g. what time profile of the health-linked benefits

- What rating model, in particular what information about the applicants should be taken into account ($\Rightarrow$ rating classes)

- What probabilistic model

- What data

Starting from the bottom:

- Data are (almost) always a problem $\Rightarrow$ sensitivity analysis can suggest adjustments in the product design

- Probabilistic model
  - ▷ does not constitute a problem by itself: Markov and semi-Markov multistate models capture whatever benefit structure
  - ▷ its implementation can constitute a problem because of lack of data ⇒ approximations frequently needed

- Appropriate rating models can be suggested by recent proposals in the context of underwritten life annuities: a large variety of products, sharing the purpose of "tailoring" the premium rate

- Various benefit structures can be conceived, aiming at a higher flexibility of the benefit amount, in line with the annuitant's needs
  - ▷ suggestions e.g. from Income Protection policies, with reduction of benefit in case of partial recovery
  - ▷ complex claim settlement and monitoring then required

Combining *rating model* and *benefit structure* can suggest interesting product design; formally, benefit given by:

$$B(t) = \Phi\big(\Pi, H(0), H(t)\big); \;\; t = 1, 2, \ldots$$

if $H(0)$ = health status at policy issue $\Rightarrow$ "double enhanced annuity", proposed by Colin Ramsay (seminar at Cass Business School, City University, London, 2017)

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Many thanks
for your kind attention !