Some Considerations on Health Insurance Premium Rates

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Product facilities

Financing health services during the economically active period

- **Natural premium system**
- **Selection due to underwriting standards**

The question of fair rating

Factors affecting the premium tariff

- Stochastic illness risk
- Selection
- Lapsing
- Dynamism in the portfolio/new entries

If pricing is strictly in accordance with the equivalence principle

Natural premium for the period *h* -

age of the insured is *x*+*t*, issuing age is *x*

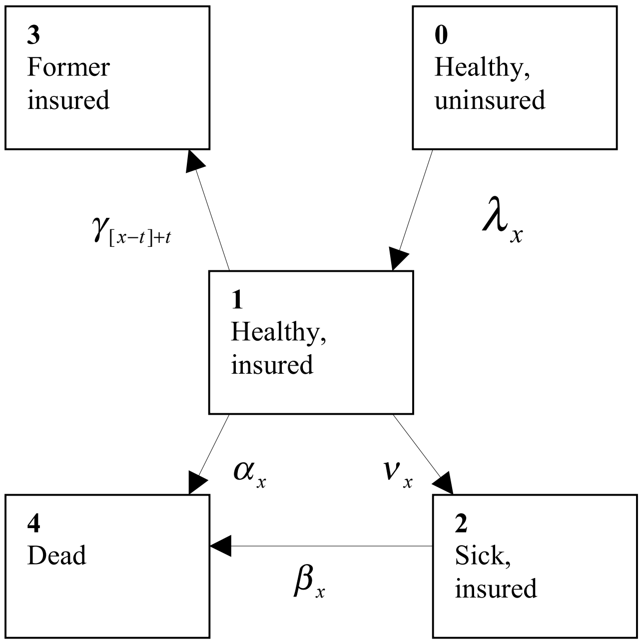
$$P^{N}_{[x]+t;h} = E(Y_{[x]+t;h}) = \sum_{i=1}^{N} p^{(i)} \cdot E(C^{(i)}_{[x]+t;h})$$

$$C^{(i)}_{[x]+t;h} = \text{the random number of claims of category } i$$

$$p^{(i)} = \text{the age-independent price of the benefit of category } i$$

$$Y_{[x]+t;h} = \text{the random total claims amount}$$

Markov model



Nordea

Claims intensity

$$\sigma_{[x]+t} = \lim_{h \to 0} \frac{E(Y_{[x]+t;h})}{h}$$

Introducing $\sigma_x^{(1)}$ and $\sigma_x^{(2)}$, where

$\sigma_x^{(1)}$ = **claims intensity for an *x*-year old "healthy person"**

$\sigma_x^{(2)}$ = **claims intensity for an *x*-year old "sick" person**

$$\sigma_{[x]+t} = \sigma_{x+t}^{(1)} + \frac{\sigma_{x+t}^{(2)} - \sigma_{x+t}^{(1)}}{1 + r(x,t;\gamma)}$$

New entries - age distribution

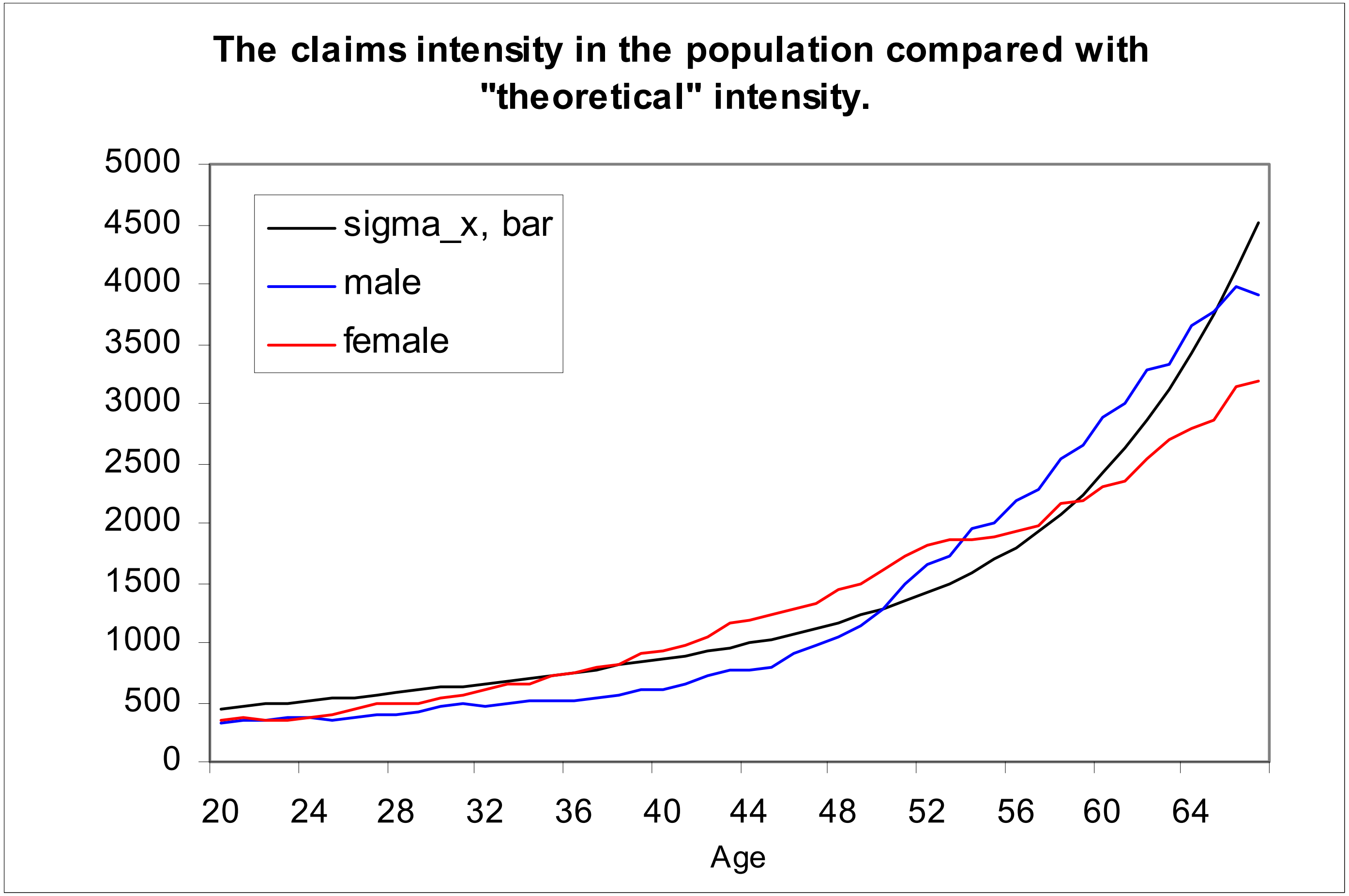
P(a persons entry age $\leq$ x|The person will sooner or later take out insurance cover) $= F(x)$

The probability density $dF(x)/dx = f(x)$

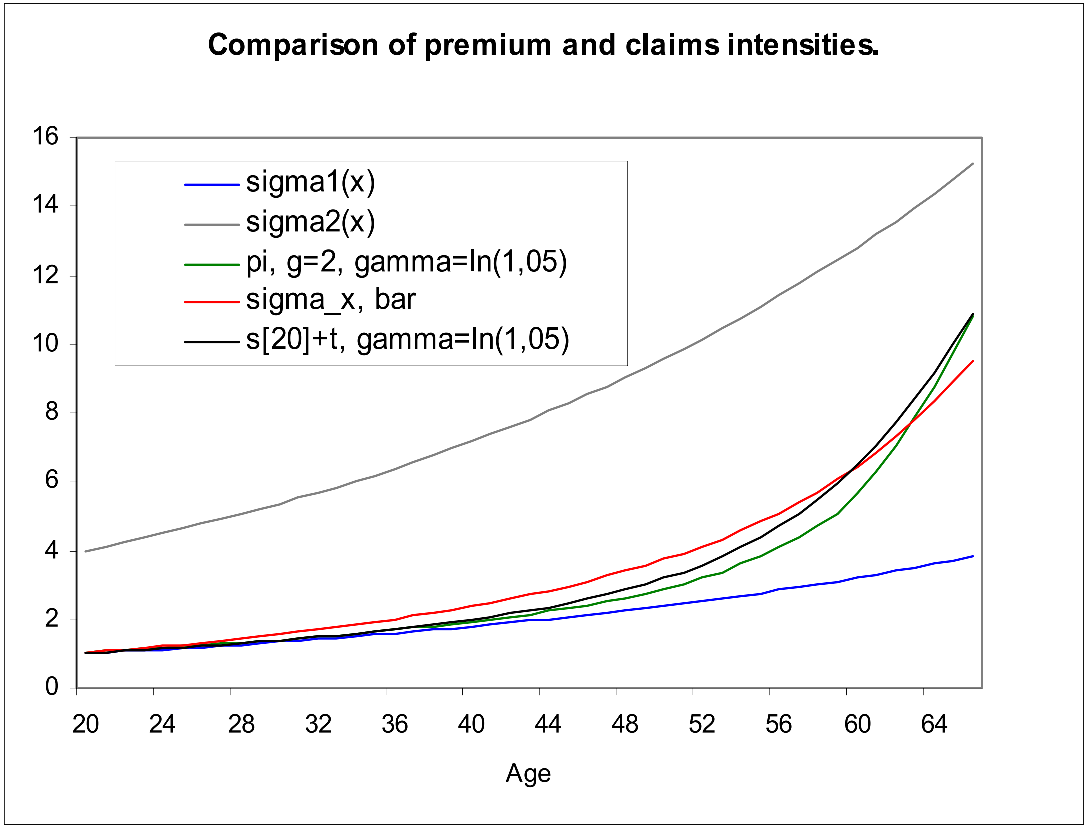
The force of entry $\lambda_x = f(x)/(1-F(x))$

A fair, aggregated premium intensity is obtained from the equivalence

$$\pi_x \cdot \int_{x_0}^{x} f(s) \cdot {}_{x-s}p_{[s]} ds = \int_{x_0}^{x} f(s) \cdot \sigma_{[s]+x-s} \cdot {}_{x-s}p_{[s]} ds$$



The claims intensity in the population compared with "theoretical" intensity.
sigma_x, bar
male
female
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
20
24
28
32
36
40
44
48
52
56
60
64
Age


Comparison of premium and claims intensities.
sigma1(x)
sigma2(x)
pi, g=2, gamma=ln(1,05)
sigma_x, bar
s[20]+t, gamma=ln(1,05)
16
14
12
10
8
6
4
2
0
20
24
28
32
36
40
44
48
52
56
60
64
Age

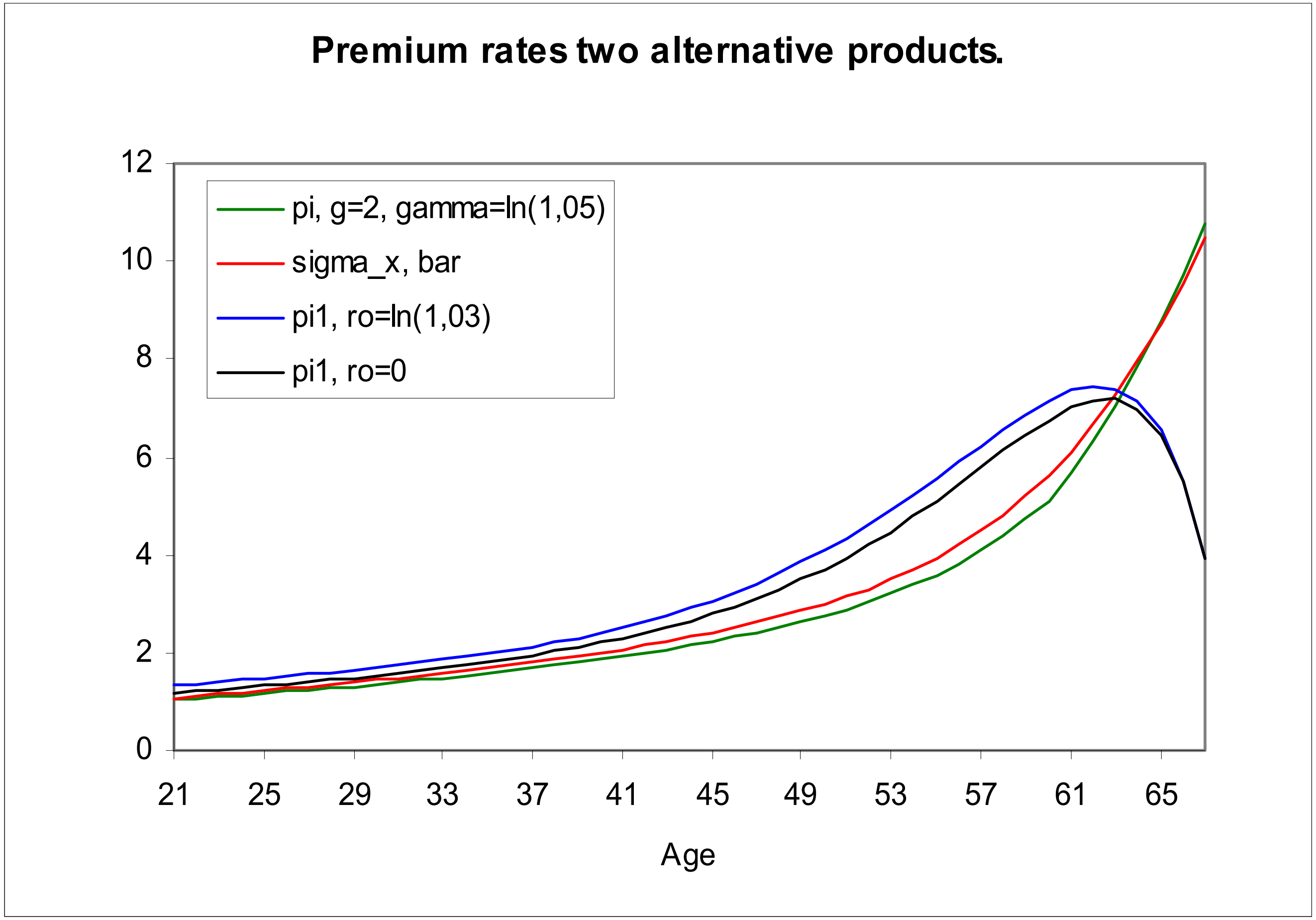
An alternative product

If an insured person enters the state defined as "sick" (state 2) :

The insurance is converted to an annuity in accordance with expected future payments

Premium intensity:

$$\pi_x^1 = \sigma_x^{(1)} + \nu_x \cdot \int_x^{x_u} P_{22}(x,\xi) \cdot \sigma_\xi^{(2)} \cdot e^{(\rho-\delta)(\xi-x)} d\xi$$



Premium rates two alternative products.
pi, g=2, gamma=ln(1,05)
sigma_x, bar
pi1, ro=ln(1,03)
pi1, ro=0
12
10
8
6
4
2
0
21
25
29
33
37
41
45
49
53
57
61
65
Age