Dynamic pricing of disability risk using credibility theory

- application in a life insurance company

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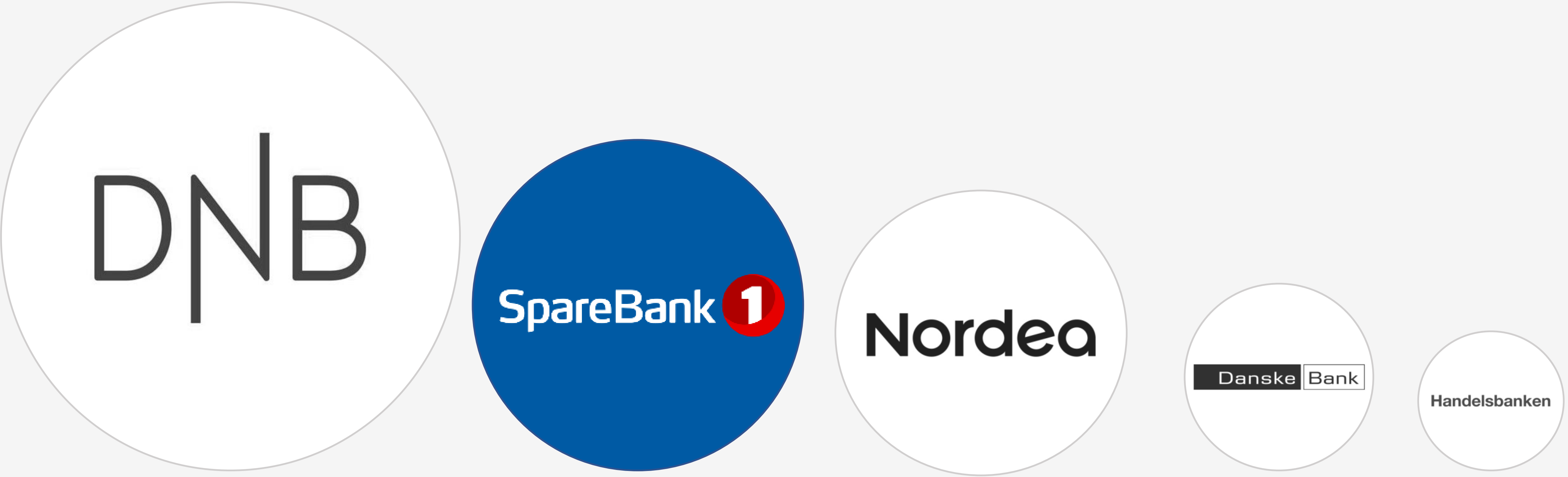
Pricing Actuary
SpareBank 1

SpareBank 1 is Norway’s second largest finance group



2698 Billion NOK
4544 Billion RAND
277 Billion EUR

1101 Billion NOK
1855 Billion RAND
113 Billion EUR

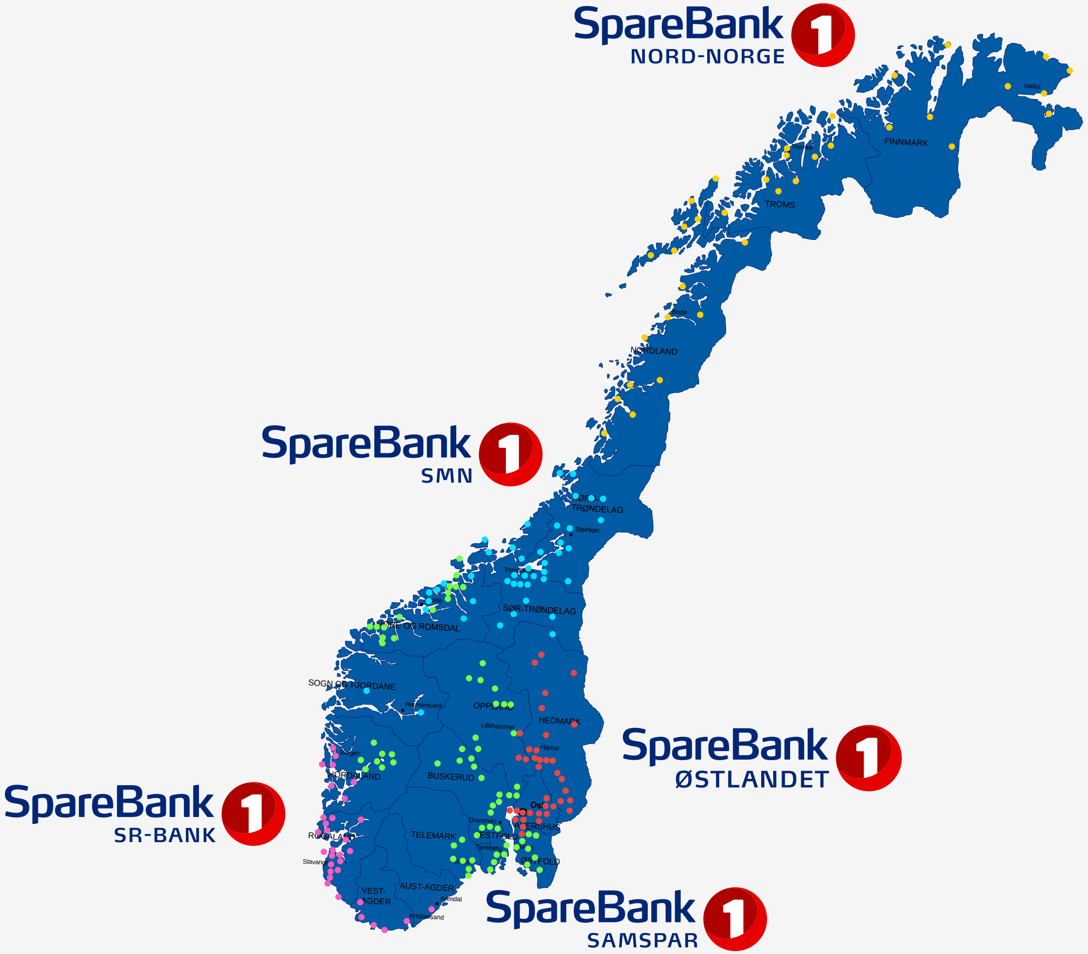
1014 Billion NOK
1708 Billion RAND
104 Billion EUR

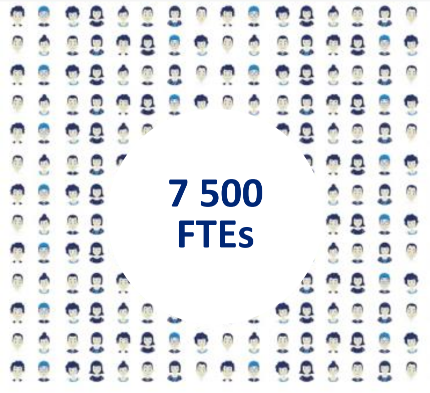
383 Billion NOK
645 Billion RAND
39 Billion EUR

248 Billion NOK
417 Billion RAND
25 Billion EUR

Measured in assets per 31.12.18

SpareBank 1 is a group of banks represented all over the country

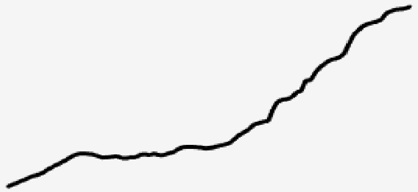




Our Defined Contribution Portfolio

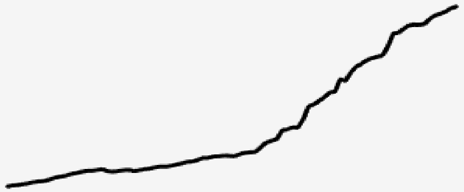
18.105

DC Customers



178.446

Employees

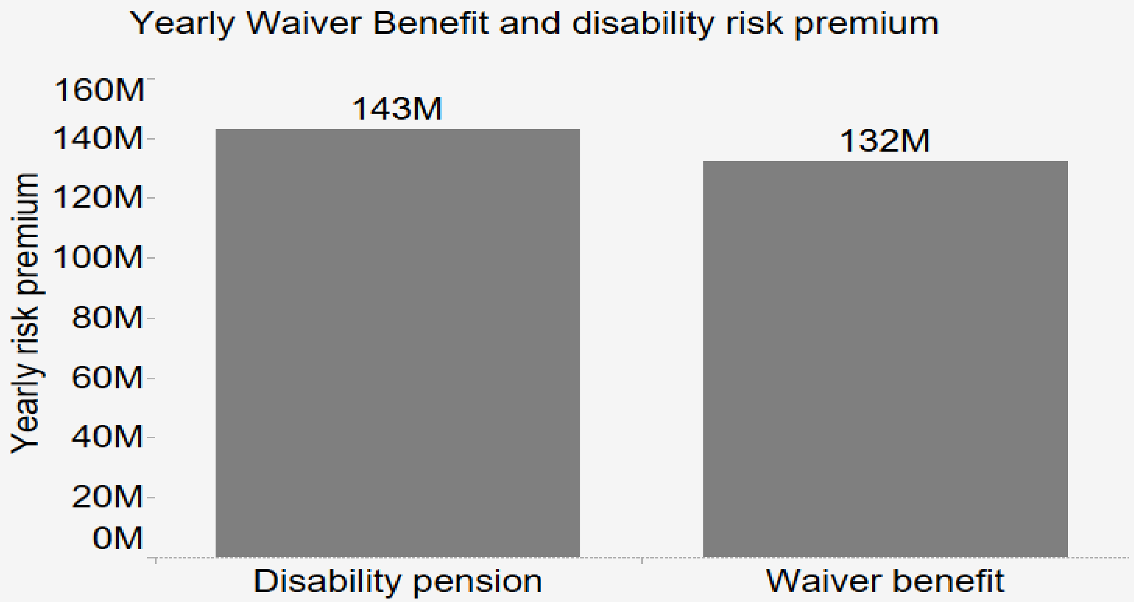


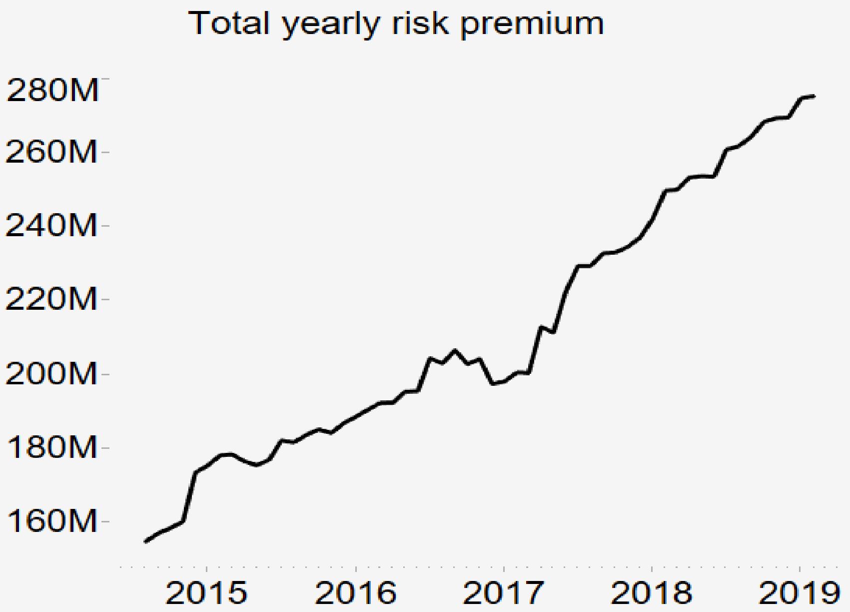
3,482 Billions

Yearly contributions

17,932 Billions

Fund Value

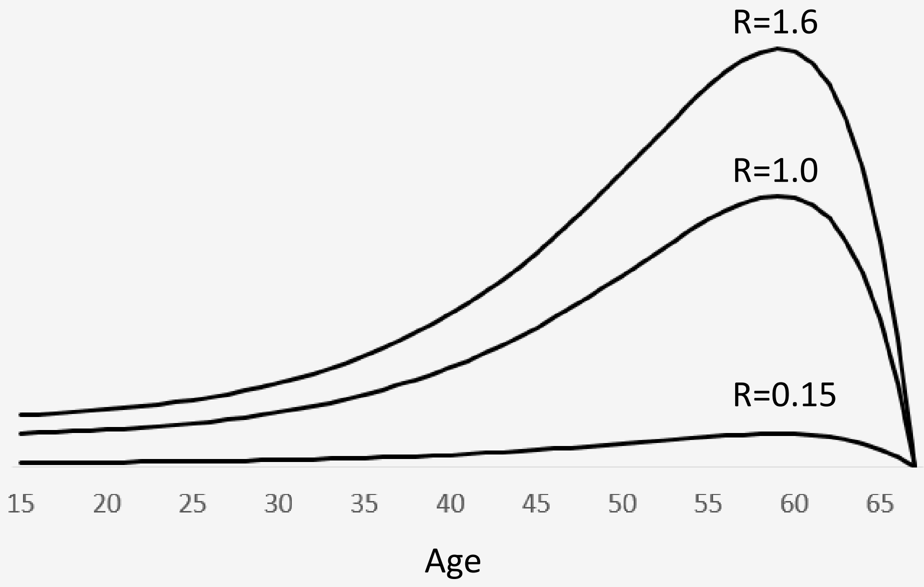


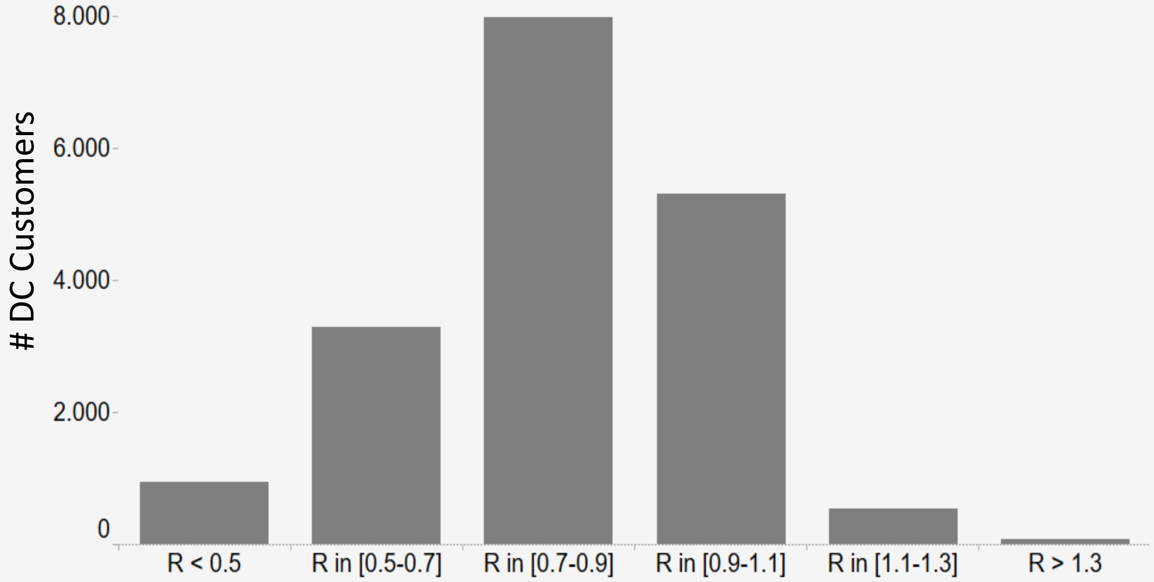


Measures in NOK
1 NOK = 1.67 Rand
1 NOK=0.10 EUR

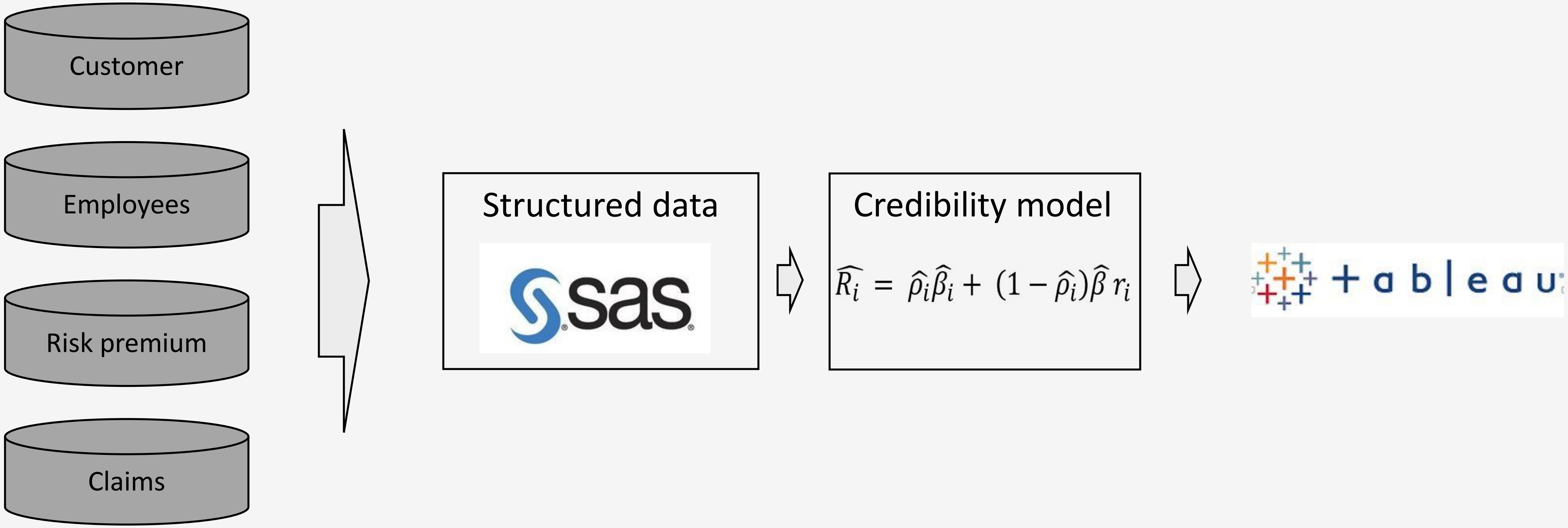
Underwriting of Defined Contributions-Schemes

- The underwriting (UW)-model decides the total disability risk for new customers
- The UW-model assign a Risk-Factor (R) to adjust the basis tariff
- The Risk-Factor continues to be the same regardless of later observed disability





A dynamic pricing process



We use the Bühlmann Credibility Model to adjust our portfolio based on observed disability

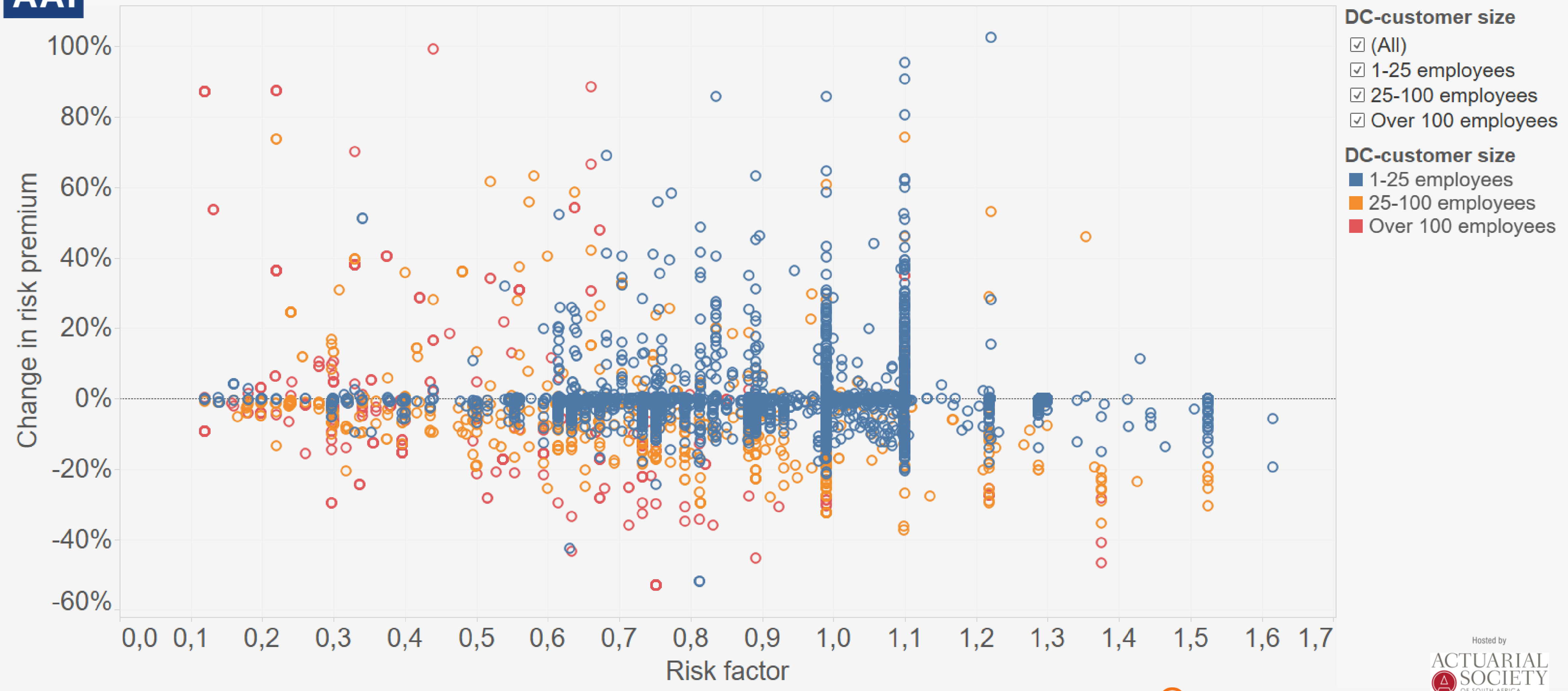
The credibility weighted model:

$$\widehat{R_i} = \widehat{\rho}_i \widehat{\beta}_i + (1 - \widehat{\rho}_i)\widehat{\beta}\, r_i$$

where the credibility is given by

$$\widehat{\rho}_i = \frac{p_i r_i}{p_i r_i + \frac{\widehat{\varphi}}{\widehat{\lambda}}}$$

p_i - number of employees for contract i summarized for all years
r_i - risk factor given at UW time
$\widehat{R_i}$ - New risk factor for contract i
$\frac{\widehat{\varphi}}{\widehat{\lambda}}$ - credibility constant
$\widehat{\rho}_i$– credibility factor for contract i
$\hat{\beta}$ - portfolio adjustment
$\widehat{\beta}_i$ - loss ratio for contract i
$\hat{\lambda}$ - avg. variance in loss ratio between contracts
$\widehat{\varphi}$ - avg. variance in loss ratio between years



100%
80%
60%
40%
20%
0%
-20%
-40%
-60%
Change in risk premium
0,0
0,1
0,2
0,3
0,4
0,5
0,6
0,7
0,8
0,9
1,0
1,1
1,2
1,3
1,4
1,5
1,6
1,7
Risk factor
DC-customer size
(All)
1-25 employees
25-100 employees
Over 100 employees
DC-customer size
1-25 employees
25-100 employees
Over 100 employees

$$R_i = \hat{\rho}_i \beta_i + (1 - \hat{\rho}_i) \beta \, r_i$$

Flo.. -200,...

Ceiling

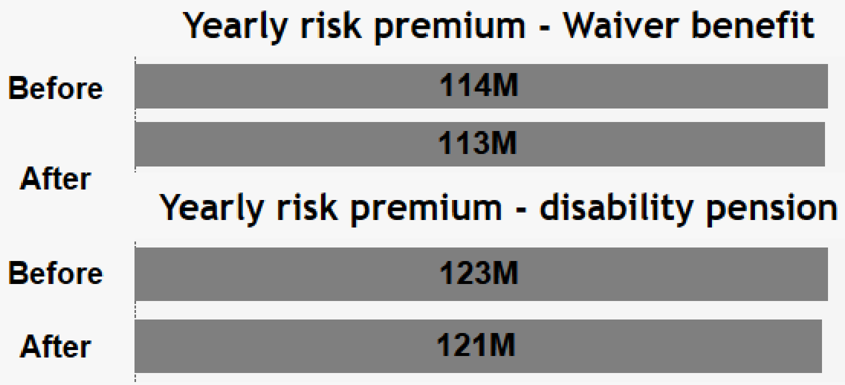
200,00%

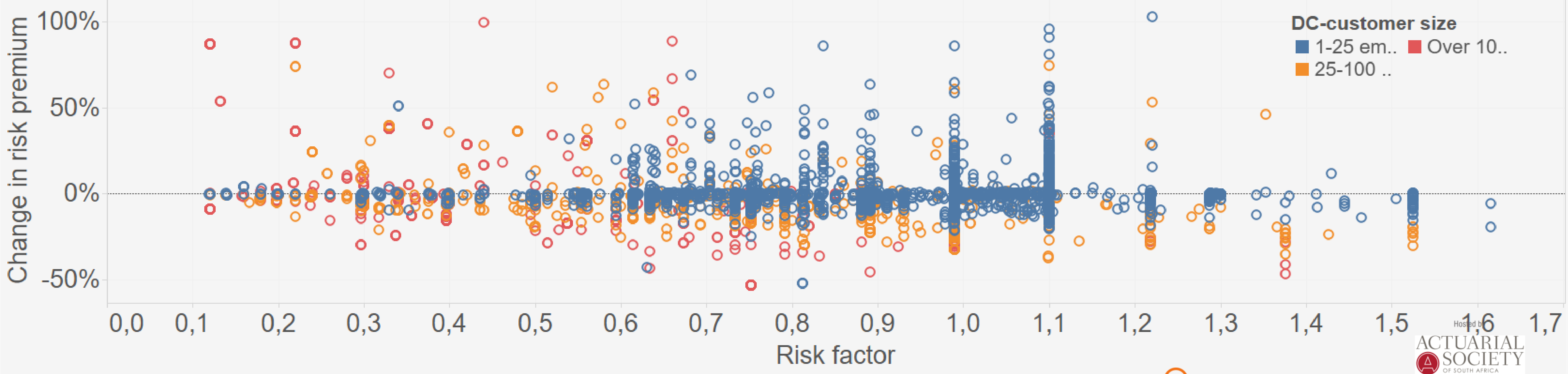
Beta

1,00

The percentage change is **-0,49%** for the Waiver benefit portfolio

The percentage change is **-0,90%** for the disability pension portfolio





IAA AAI

Thank you for your attention

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