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UNISEX PRICING OF GERMAN PARTICIPATING LIFE ANNUITIES – BOON OR BANE FOR POLICYHOLDER AND INSURANCE COMPANY?

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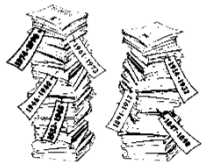
Germany's insurance environment

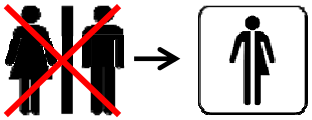
Life insurance contracts are traditionally very popular in Germany:
92.5m contracts for 82m total population, thereof 73.5m old age provision contracts



The environment for offering and buying annuity products changed dramatically:

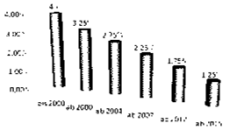
Abolishment of tax privileges in 2004: endowment insurance → annuity insurance
Approx. 38% of new contracts are annuity contracts

Since December 2012: Unisex



Life Insurance Reform Act (2014)

Guaranteed Interest Rate



Source: GDV 2015, Lebensversicherung in Zahlen

Related Research

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Gender-based/ Gender-neutral annuity pricing

- Gaudecker, H.-M.von and Weber, C. (2006): *Mandatory Unisex Policies and Annuity Pricing : Quasi-Experimental Evidence from Germany*. Mannheimer Manuskripte zu Risikotheorie, Portfolio Management und Versicherungswirtschaft 166.

- Finkelstein, A., Poterba, J. and Rothschild, C. (2009): *Redistribution by insurance market regulation: Analyzing a ban on gender-based retirement annuities*. Journal of Financial Economics 91 (1): 38-58.

Participating payout life annuities in the payout phase

- Maurer, R., Rogalla, R. and Siegelin, I. (2013): *Participating Payout Life Annuities: Lessons from Germany*. ASTIN Bulletin 43 (2): 159-187.

- Maurer, R., Mitchell, O. S., Rogalla, R. and Siegelin, I. (2014): *Accounting and Actuarial Smoothing in Participating Life Annuities: Insurer Profitability and Retiree Benefits*. Pension Research Council Working Paper

As to our best knowledge, the utility and the shortfall influence of gender-neutral pricing during payout phase of annuities have not been analyzed yet.

Research Problems

What impact does a change in the market and regulatory environment, especially the unisex pricing of participating annuities, have on

policyholders **and** ***insurance companies?***

- How does the policyholder's wellbeing change depending on actual mortality and gender mix realizations, deviating from the calculation assumptions on gender mix?
- To what extent are males disadvantaged by switching to unisex pricing as compared to females?
- How large is the utility difference between male and female when comparing gender-neutral policyholder's benefit?

- How is the profitability and stability of the insurance company affected depending on actual mortality and gender mix realizations, deviating from the calculation assumptions on gender mix?

- What impact has the life insurance reform law (LIRA/LVRG) on policyholder and insurer?

Starting point: Market Analysis

Market Analysis (Bisex/Unisex): Immediate life annuity, 100,000€ single premium, age 67

	Total annuity in € p.m.			Difference in %	
	Women	Unisex	Men	Women	Men
Minimum	362	371	388	2	-4
Median	373	390	420	5	-7
Maximum	406	397	457	-2	-13

→ Unique sample, including the vast majority of the tariffs in use by annuity providers in German insurance market.

Introduction of unisex calculation increases benefits for females, but considerably lowers the benefits for males.

. Source: Morgen & Morgen Office, LV Lotse (2012/2013)

Market Analysis: Implied Gender Mix

Actuarially fair benefits for gender mix assumptions

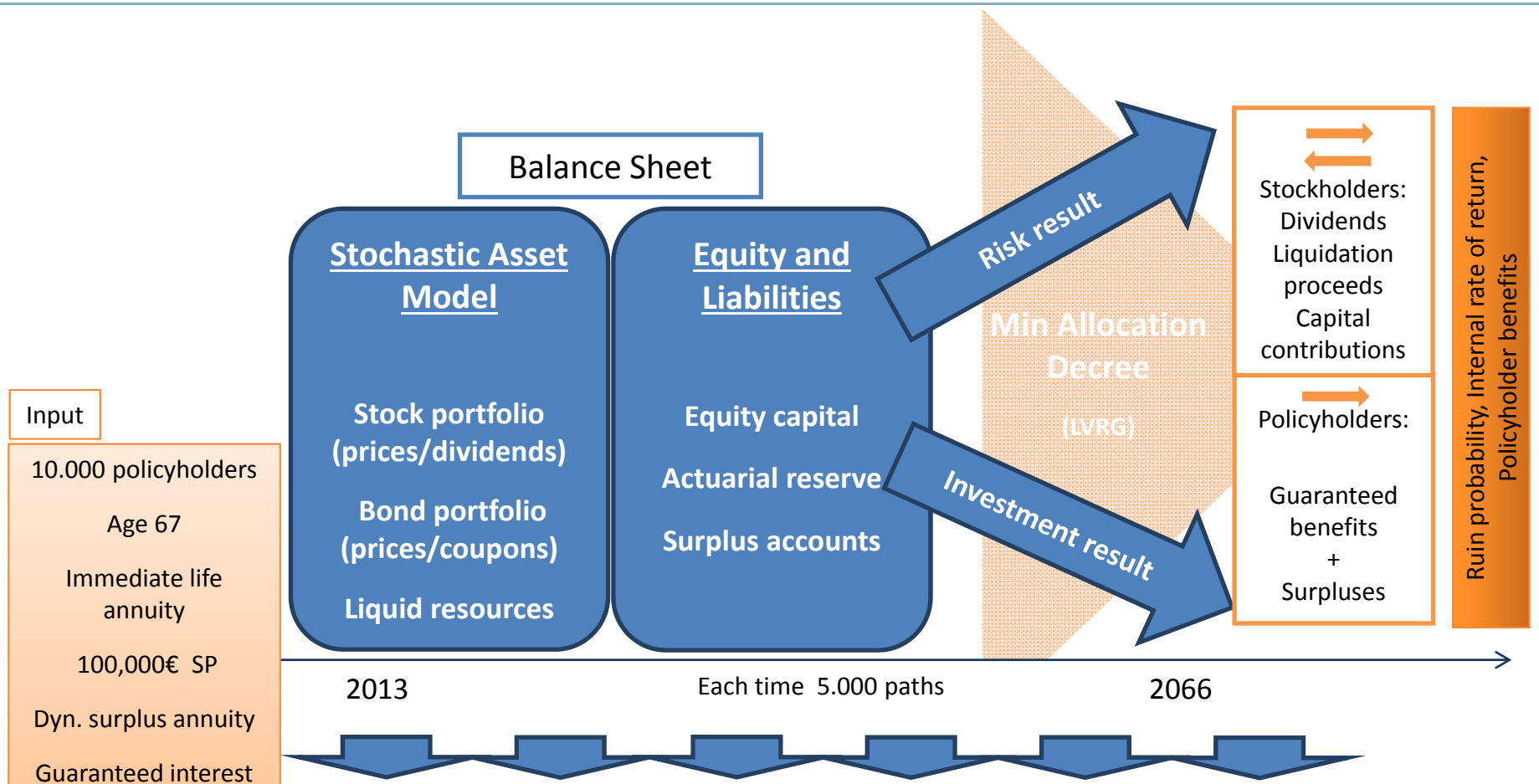
Female share in %	0	10	20	30	40	50
Actuarially fair Benefit in € p.m.	449	443	438	433	428	423
Female share in %	**60**	**70**	**80**	**90**	**100**	
Actuarially fair Benefit in € p.m.	418	413	409	404	400	

- Actuarial calculation of unisex benefit for varying assumed female share: Immediate life annuity, 100,000€ SP, age 67, life table “DAV 2004 R”, guaranteed interest 1.75%, no cost loads.
- Empirically observed median value for unisex total annuity of 390 € results in the benefit of 416 € after the no-loads-adjustment (with market consistent cost loadings).
- Market-based implied gender mix is **65/35 (females/males)** for immediate life annuities.

Calculation Assumptions

Immediate single premium annuity	
Pool size	10,000 policyholders
Age	67
Gender	Unisex/Bisex
Guaranteed interest rate **Life table**	1,75%/1.25% DAV 2004 R
Single premium	100,000 €
Surplus appropriation	Dynamic surplus annuity

Model Description



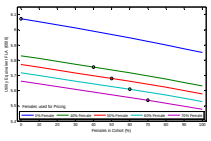
Stochastic mortality model:

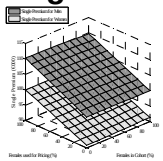
- Systematic longevity risk: Cairns-Blake-Dowd Model
- Individual dying process: Markov process

Results: Policyholder View

Based on annuitant‘s lifelong utility (with stochastic mortality) and utility equivalents

Figure 1 **Figure 2** **Table 1**





- Unisex calculation causes utility equivalent deterioration for men and utility equivalent improvement for women
  → consistent in direction with empirical observations, but symmetric (no overall utility loss for the insured pool of males and females!)

- Annuitant’s utility depends both on the assumed and realized female share: The higher the assumed/realized female share, the lower the utility equivalent. LIRA has no significant influence.

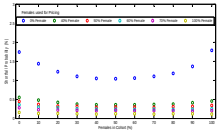
- Comparison with the *gender-based* calculation using utility equivalents: To maintain the same utility for (fe)males, a single premium increase of maximum (-)+10% is needed. Pricing assumptions are crucial.

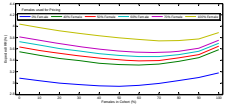
- Comparison with the *gender-neutral* calculation using utility equivalents: To maintain the same utility as the opposite sex, a change in single premium of approximately 1% is needed.

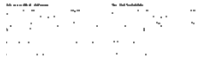
Results : Company View

Figure 3 **Table 2**

Based on a one-product insurance company model with a pool of 10,000 annuitants







- Ruin probability increases with the decreasing assumed female (max. 2pp) share and is the lowest for a fairly balanced realized gender mix.
- Expected internal rate of return increases with the growing assumed pricing female share (max. 1pp) and is the lowest for a fairly balanced realized gender mix.
- **Introduction of LIRA/LVRG slightly increases the internal rate of return (~5bp).**
- **Introduction of LIRA/LVRG noticeably decreases the ruin probability for all analyzed cases (~20bp).**

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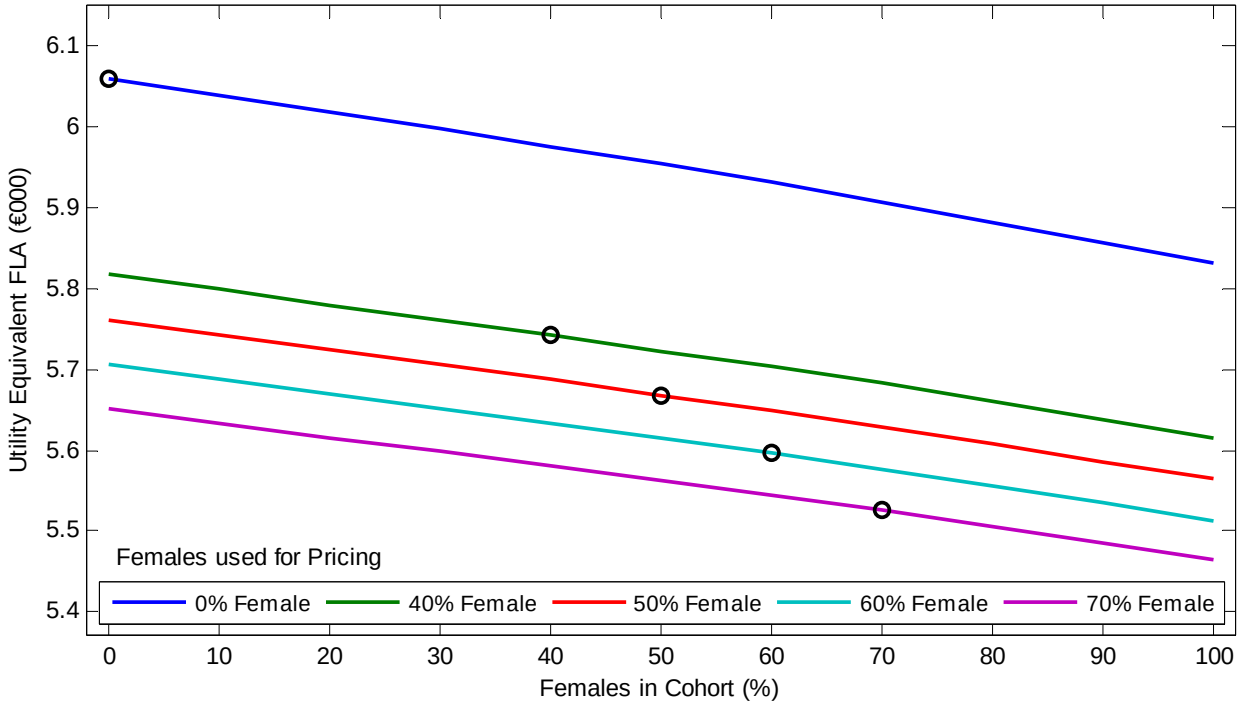
Thank you for your attention!

BackUp

(Figures and Tables)

Figure 1

Gender mix assumed for the calculation and realized mix in actual portfolio: Impact on policyholder benefits

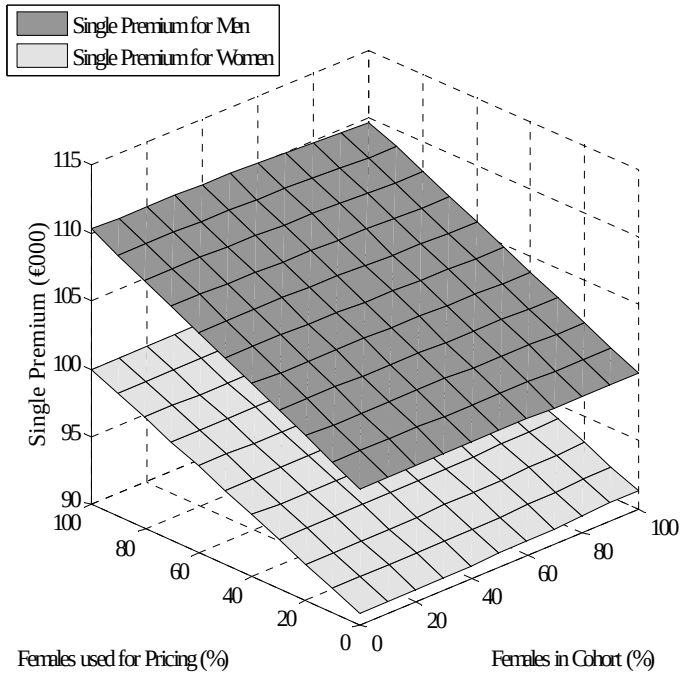


- Benefit equivalents, fixed pension (in €000) for men
- The horizontal axis displays the realized women quota in the portfolio
- Different colours represent different gender compositions assumed for the calculations
- The dots show equal gender mixes for the calculation and realization
- Man, age 67, one-off contribution 100.000€

Figure 2

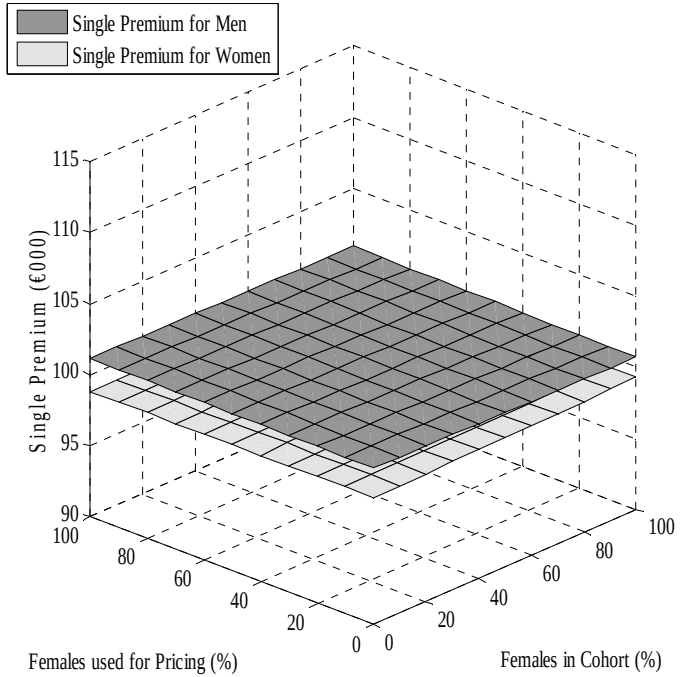
One-off contributions for pension benefit equivalents

Unisex versus Bisex



One-off contribution, which a policyholder with a Unisex contract has to pay to achieve the benefit equal to the Bisex-pension

Men versus women in Unisex-calculation



One-off contribution, which a policyholder with a Unisex contract has to pay to achieve the benefit equal to the benefit of Unisex contract holder of the other gender

Initial one-off contribution: 100.000€

Table 1

LIRA influence on policyholder

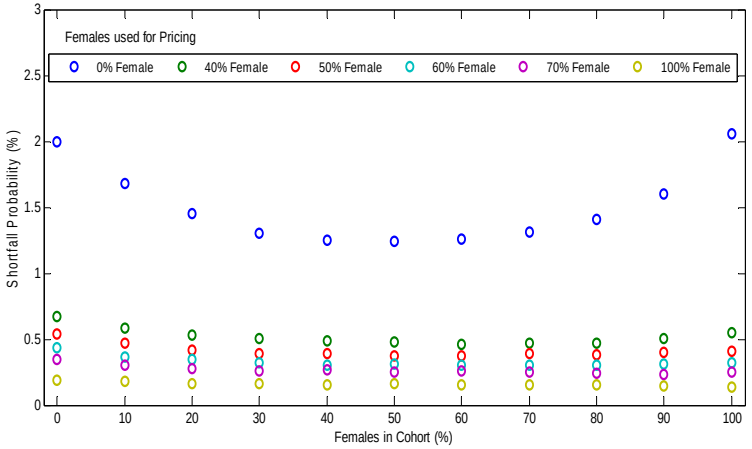
	Before LIRA, GIR=1.75%			After LIRA, GIR=1.75%			After LIRA, GIR=1.25%		
	Assumed Females for Annuity Pricing								
Females in Cohort	100%	50%	0%	100%	50%	0%	100%	50%	0%
50%	110,108	105,091	100,000	110,106	105,091	100,000	110,965	105,551	100,000

- Single premium that a man has to pay for a unisex calculated PLA to reach the same utility equivalent FLA as with a gender-based calculation. Vertical axis realized share of females in the actual cohort, horizontal axis females used for pricing guaranteed benefits. PLA single premium: 100,000€.

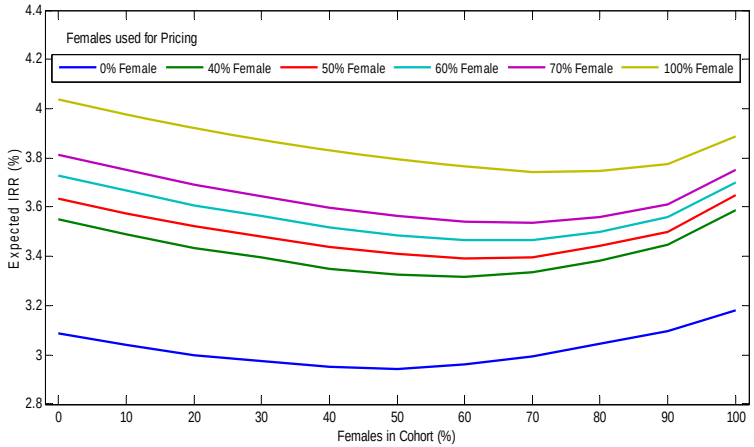
Figure 3

Gender mix assumed for the calculation and realized mix in actual portfolio : Stability and profitability (before LVRG)

Stability



Profitability



- Different colours represent different gender compositions assumed for the calculations
- The horizontal axis displays the realized women quota in the portfolio

Table 2

LIRA influence on insurer

Expected Internal Rate of Return

Females in Cohort	Before LIRA: Assumed Females for Annuity Pricing 0%	50%	100%	After LIRA: Assumed Females for Annuity Pricing 0%	50%	100%
100%	3.18	3.65	3.89	3.18	3.66	3.91
50%	2.94	3.41	3.79	2.98	3.46	3.84
0%	3.09	3.64	4.04	3.12	3.68	4.07

Shortfall Probability

Females in Cohort	Before LIRA: Assumed Females for Annuity Pricing 0%	50%	100%	After LIRA: Assumed Females for Annuity Pricing 0%	50%	100%
100%	2.05	0.41	0.14	1.86	0.29	0.06
50%	1.24	0.38	0.16	1.01	0.18	0.03
0%	2.00	0.54	0.19	1.83	0.41	0.11

- Expected internal rate of return and shortfall probability before (left) and after (right) validity of LIRA with a guaranteed interest rate of 1.75%. Vertical axis realized share of females in the actual cohort, horizontal axis females used for pricing guaranteed benefits. PLA single premium: 100,000€.

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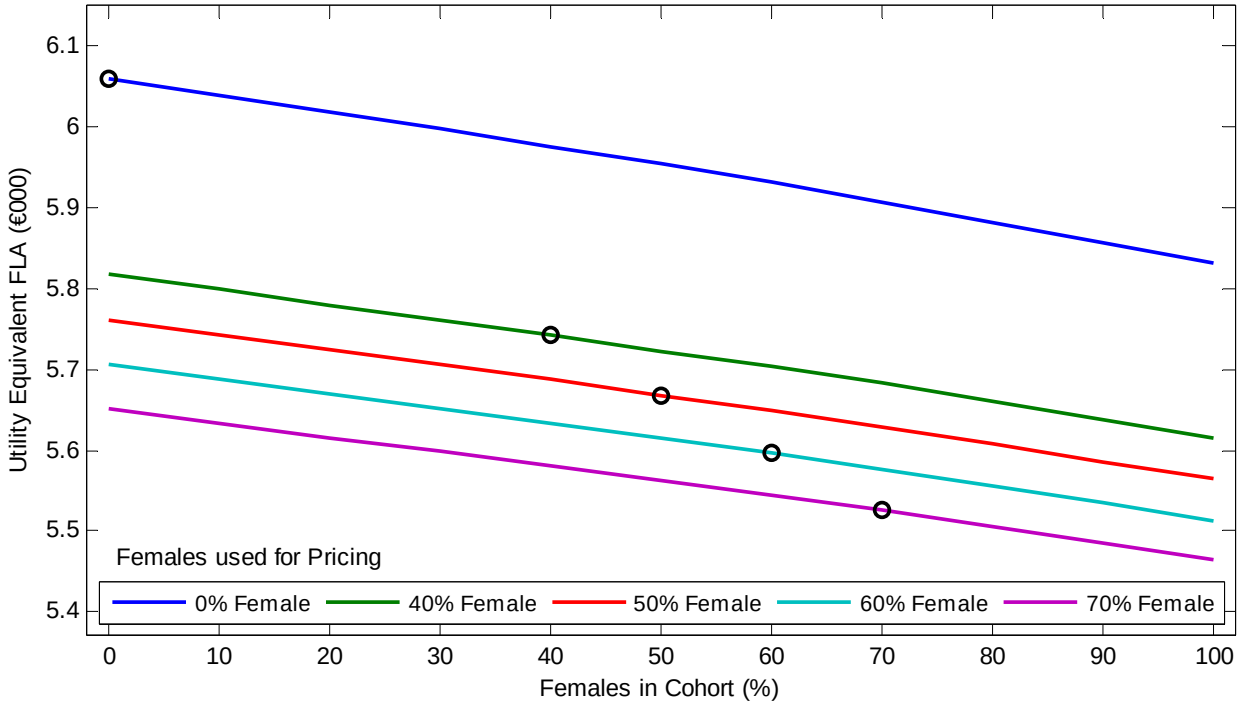
Gender mix assumed for the calculation and realized mix in actual portfolio: Impact on the policyholder benefits



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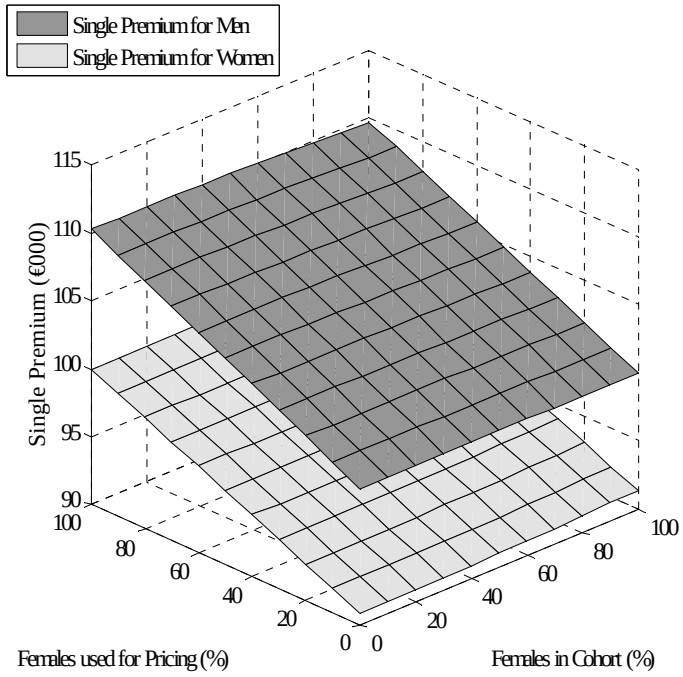

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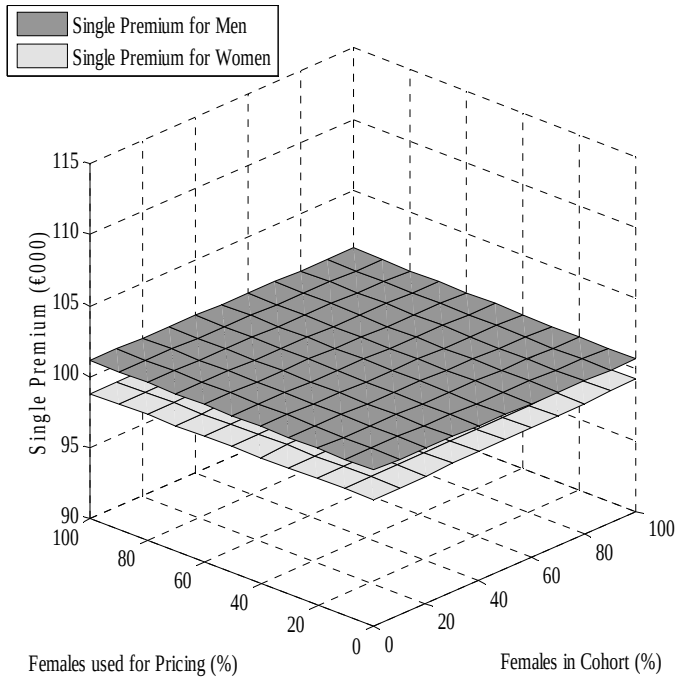

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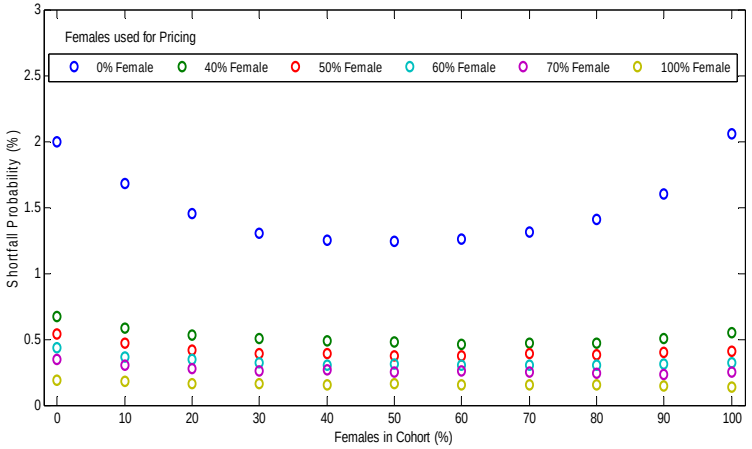

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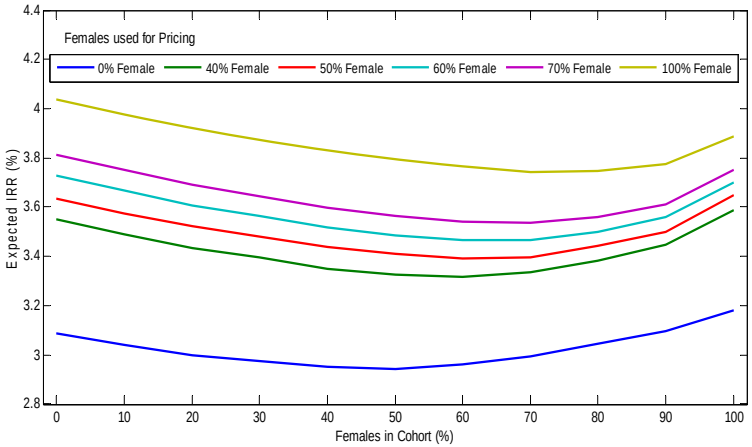

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