Modeling Non-Self-Sufficiency Benefits in ALM-Based Self-Management

Based on a work by T. Tafaro, V. Marchisio, A. De Sisto, N. Montemarano

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About the speakers

- **Valerio Marchisio** – *Partner Specialist, Crenca & Associati*

Degree cum laude and Ph.d. in Mathematics.
Partner C&A, Finance Specialist, Risk Manager for supplementary health funds and pension funds.
University and Master lecturer, advanced and professional training course lecturer.

About the speakers

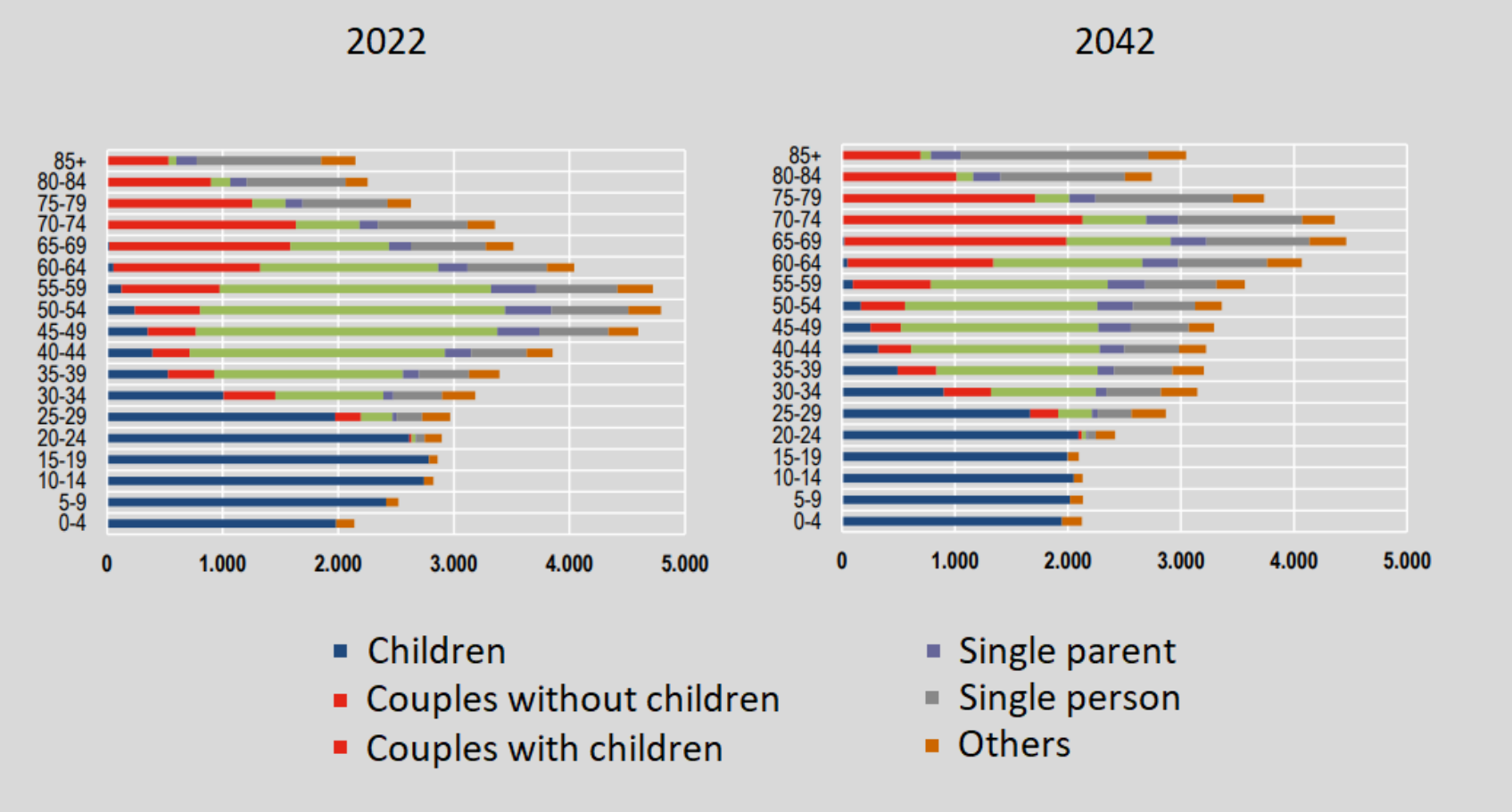
- **Andrea De Sisto** – *Consultant, Crenca & Associati*

Degree in finance with curriculum in actuarial and insurance sciences
Consultant C&A, specialized in social security and welfare.

- Information on Crenca & Associati
  Crenca & Associati, independent actuarial and risk management associate firm. Insurance, welfare, risk management, accounting, corporate consultancy and ERM.

Introduction: non-sufficiency problem

- ISTAT (Italian Statistical Institute) forecast. Data in thousands.



Introduction: non-sufficiency problem

- In Italy, in 20 years, estimation of an increase of more than 10 million alone people.
  In the following table the ISTAT forecast.
  Data in thousands.

	2021	2041*
Single men with children	532	770
Single women with children	2,197	2,318
Single men witout children	3,584	4,242
Single women without children	4,874	5,967

**Average scenario*

Introduction: non-sufficiency problem

- We expect an increase in healthcare needs and, consequently, an increase of the healthcare expenses.
- In the last year, about 14 million of people in Italy has given up one or more medical treatments.
- In Italy, more than 10 million of workers are members of a supplementary health fund.
- There is still a gap between the medical needs of the people and the government planning about the first and the second pillar healthcare.

Introduction: non-sufficiency problem

- We expect an increase of non-sufficient people with a chronic disease or disability.
- **In this work we have developed a model of a health fund to cover the risk of loss of self-sufficiency via *long-term care* (LTC)**.
- "LTC" refers to the provision of medical and non-medical services for non-sufficient people who need daily assistance in long period.
- The technical goal is **to build a welfare model satisfying the new needs arising from the aging of the population and the loss of self-sufficiency**. In the simulation, different hypotheses are used and it is estimated the evolution of the average fair premium required.

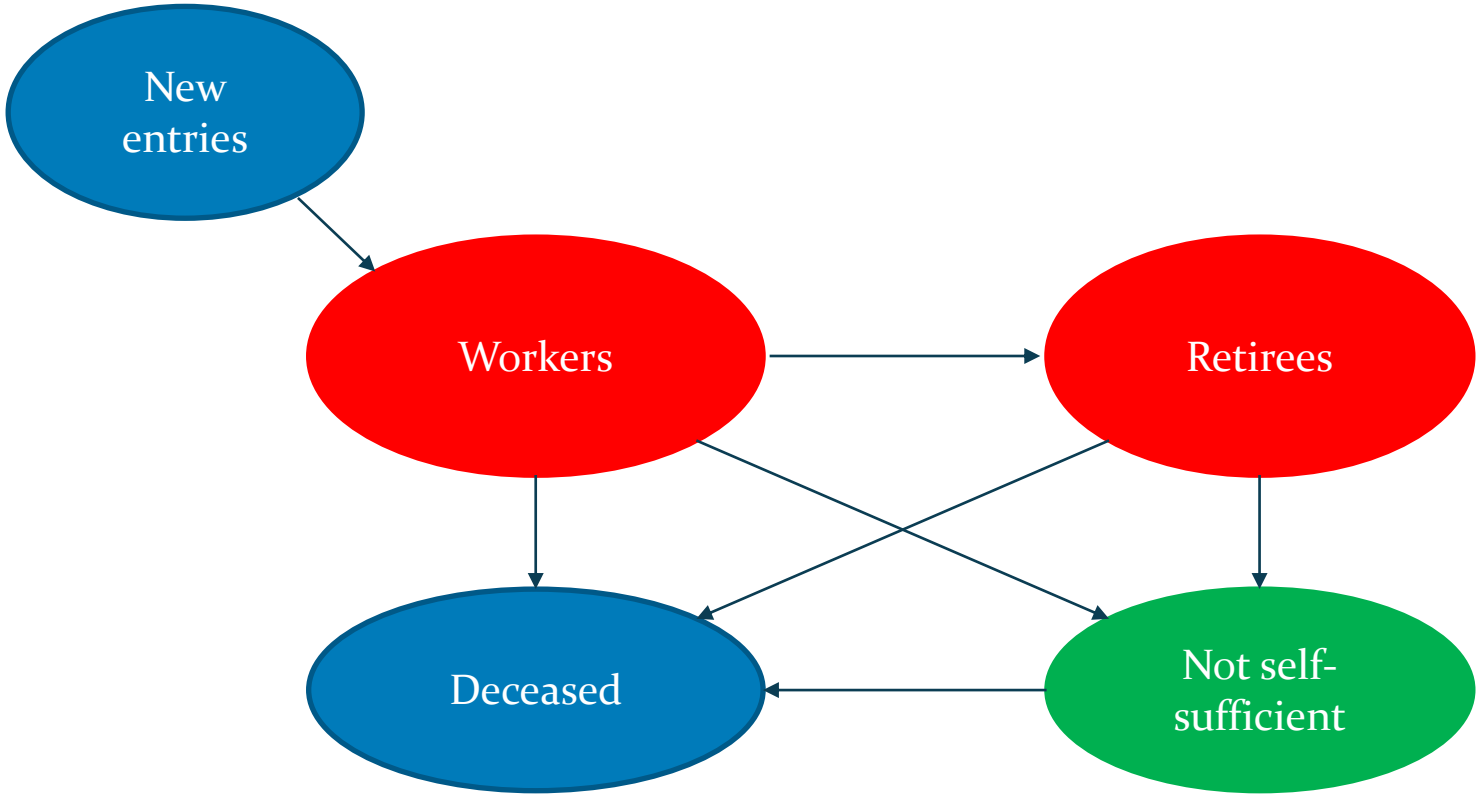
The problem - hypothesis

Type of fund	Collective health insurance fund
Model	Stochastic approach (Monte-Carlo simulation)
Users	Workers and future retirees. Premium payable annually only by workers
Fund financing system	Collective capitalization
Duration of insurance coverage	Lifetime (users covered during the period of work and retirement)
Mortality table for self-sufficient	ISTAT 2019 projected table
Mortality table for not self-sufficient	Projected mortality tables developed by ANIA in collaboration with the Sapienza University of Rome, "*mid*" scenario
Probability of becoming non-self-sufficient	Projected probabilities developed by ANIA in collaboration with the Sapienza University of Rome, assuming 3 different hypotheses: • "low" scenario • "*mid*" scenario • "*high*" scenario

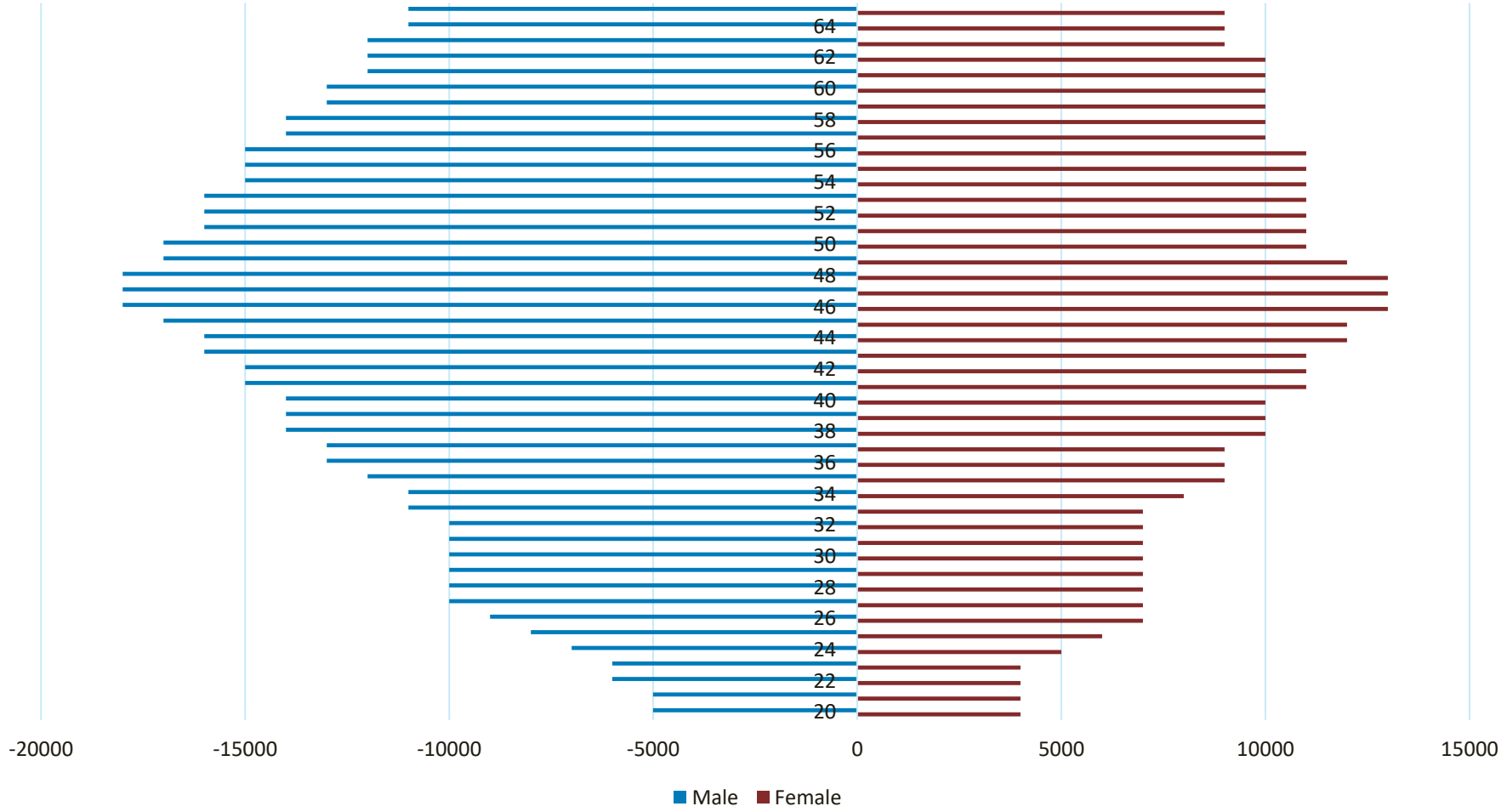
The problem - hypothesis

Retirement age	100% at 66 years old
Initial number of members	1,000,000 workers, assuming the Italian age and sex distribution
New entries into the group of workers	Number of workers to keep the initial number and male/female ratio constant. Age distribution as in Italy
Inflation rate and interest rate	0% (inflation-neutral model)
LTC annuity	12,000 € - lifetime
Operating expenses and profits	Excluded
Premium	Average premium over a 30-years period, estimated at the beginning and after 30 years

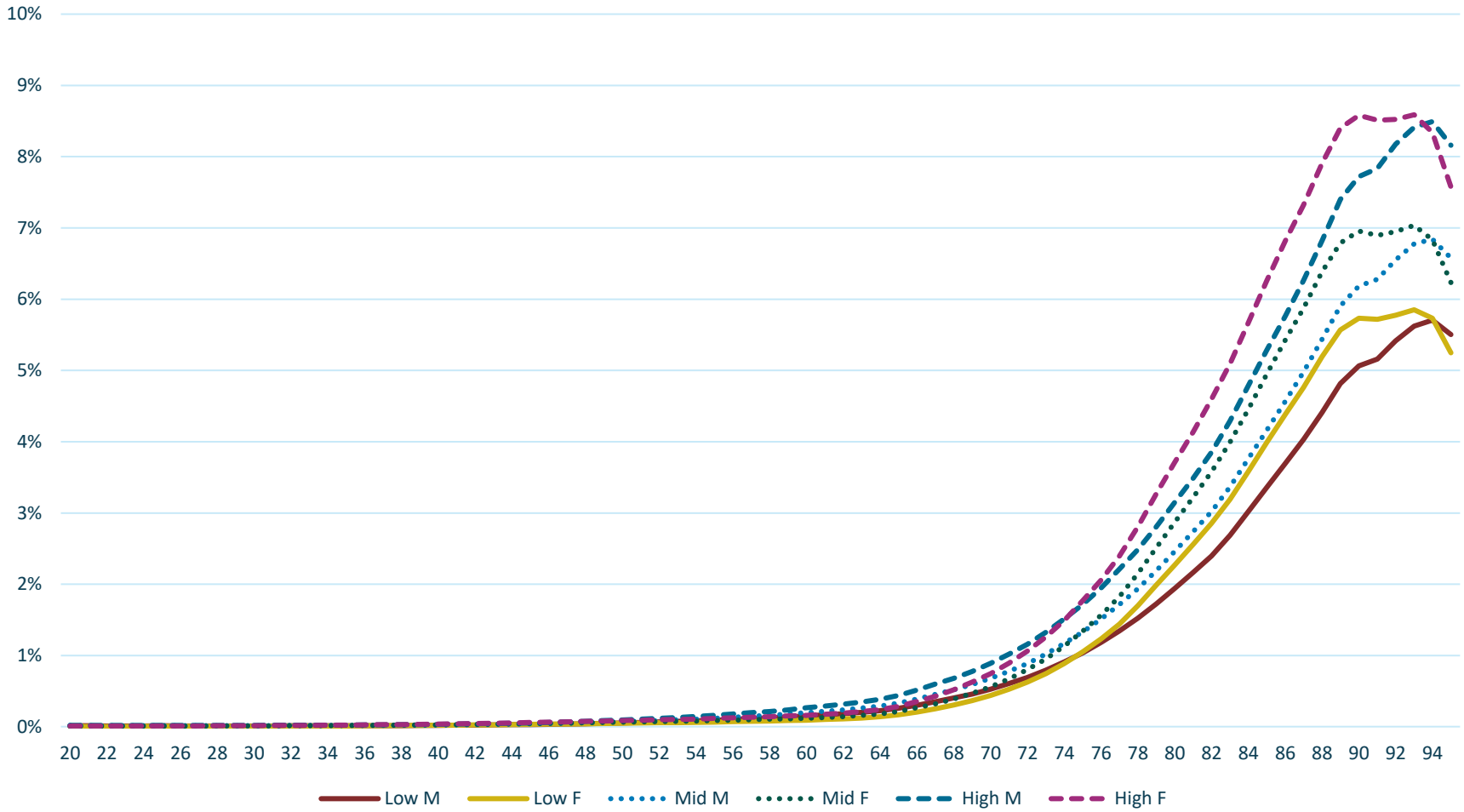
Model groups and group transition



Initial number of workers by age and sex



Initial probability of becoming non-self-sufficient (in 2024)



De Angelis P., Di Falco L. "*Assicurazioni sulla salute: caratteristiche, modelli attuariali e basi tecniche*". Mulino, 2016.

Simulation – «mid scenario»

Fair premium per worker in t_1 (2024): 205,46€ Fair premium per worker in t_{31} (2054): 388,57€.

Year	Number of workers	Number of retirees	average age of workers + retirees	New LTC from workers	New LTC from retirees	Cumulative total number of LTC	Total technical provisions (k/€)	Total LTC payments in the year (k/€)	Total premium (k/€)	Cumulative assets (k/€)
2023	1,000,000	-	44.9	-	-	-	-	-	-	-
2024	1,000,000	19,774	45.5	705.5	-	705.5	53,303	8,466	205,461	196,995
2025	1,000,000	39,120	46.1	725.0	65.4	1,406.6	104,018	16,879	205,461	385,576
2026	1,000,000	59,026	46.6	722.0	198.8	2,084.1	150,461	25,009	205,461	566,027
2027	1,000,000	79,463	47.1	725.8	387.5	2,752.6	193,893	33,031	205,461	738,457
2028	1,000,000	99,484	47.6	755.7	648.7	3,442.4	236,907	41,309	205,461	902,609
…	…	…	…	…	…	…	…	…	…	…
2033	1,000,000	201,311	50.0	775.6	3,111.5	7,348.1	435,630	88,177	205,461	1,587,647
…	…	…	…	…	…	…	…	…	…	…
2038	1,000,000	299,760	52.0	760.9	7,643.3	12,445.2	612,702	149,342	205,461	2,000,040
…	…	…	…	…	…	…	…	…	…	…
2043	1,000,000	393,934	53.3	759.6	14,285.1	19,335.7	774,507	232,028	205,461	2,035,580
…	…	…	…	…	…	…	…	…	…	…
2048	1,000,000	453,482	54.4	718.0	20,835.8	25,836.3	896,104	310,036	205,461	1,665,459
…	…	…	…	…	…	…	…	…	…	…
2053	1,000,000	476,378	55.1	708.6	25,445.3	30,428.3	**964,852**	365,140	205,461	**964,852**
2054	1,000,000	477,889	55.3	710.1	25,986.2	30,961.5	970,985	371,538	388,566	981,881
2055	1,000,000	477,464	55.3	703.0	26,360.6	31,334.4	976,265	376,013	388,566	994,434
2056	1,000,000	476,188	55.5	694.4	26,718.5	31,689.9	979,412	380,279	388,566	1,002,722
2057	1,000,000	474,105	55.6	705.8	27,091.1	32,072.0	982,093	384,864	388,566	1,006,424
2058	1,000,000	472,259	55.8	729.2	27,344.0	32,350.1	985,096	388,201	388,566	1,006,789

First 30 years

Simulation – «low scenario»

Fair premium per worker in t_1 (2024): 144,47€ Fair premium per worker in t_{31} (2054): 280,67€.

Year	Number of workers	Number of retirees	average age of workers + retirees	New LTC from workers	New LTC from retirees	Cumulative total number of LTC	Total technical provisions (k/€)	Total LTC payments in the year (k/€)	Total premium (k/€)	Cumulative assets (k/€)
2023	1,000,000	-	44.9	-	-	-	-	-	-	-
2024	1,000,000	19,794	45.5	560.5	-	560.5	41,633	6,726	144,470	137,744
2025	1,000,000	39,190	46.1	562.9	46.7	1,099.4	80,414	13,193	144,470	269,020
2026	1,000,000	59,160	46.6	555.1	147.2	1,607.6	115,743	19,291	144,470	394,199
2027	1,000,000	79,686	47.1	563.1	299.2	2,125.4	149,460	25,505	144,470	513,163
2028	1,000,000	99,776	47.7	567.0	498.2	2,633.9	182,011	31,607	144,470	626,026
…	…	…	…	…	…	…	…	…	…	…
2033	1,000,000	203,064	50.1	551.9	2,302.4	5,381.7	321,142	64,580	144,470	1,094,817
…	…	…	…	…	…	…	…	…	…	…
2038	1,000,000	304,683	52.1	528.7	5,555.0	8,979.0	446,144	107,748	144,470	1,369,774
…	…	…	…	…	…	…	…	…	…	…
2043	1,000,000	404,770	53.5	484.0	9,991.2	13,469.1	539,072	161,629	144,470	1,392,036
…	…	…	…	…	…	…	…	…	…	…
2048	1,000,000	472,348	54.7	458.0	14,578.8	17,896.6	611,213	214,759	144,470	1,149,895
…	…	…	…	…	…	…	…	…	…	…
2053	1,000,000	502,083	55.6	461.4	18,217.5	21,490.9	**660,741**	257,891	144,470	**660,741**
2054	1,000,000	504,627	55.7	457.6	18,699.5	21,962.9	666,703	263,555	280,674	677,860
2055	1,000,000	505,205	55.9	469.4	19,048.4	22,314.0	671,550	267,768	280,674	690,766
2056	1,000,000	504,762	56.1	464.7	19,331.6	22,609.5	675,500	271,314	280,674	700,125
2057	1,000,000	503,463	56.2	455.2	19,673.5	22,947.5	676,579	275,370	280,674	705,429
2058	1,000,000	502,231	56.3	467.5	19,933.7	23,210.6	678,188	278,527	280,674	707,576

First 30 years

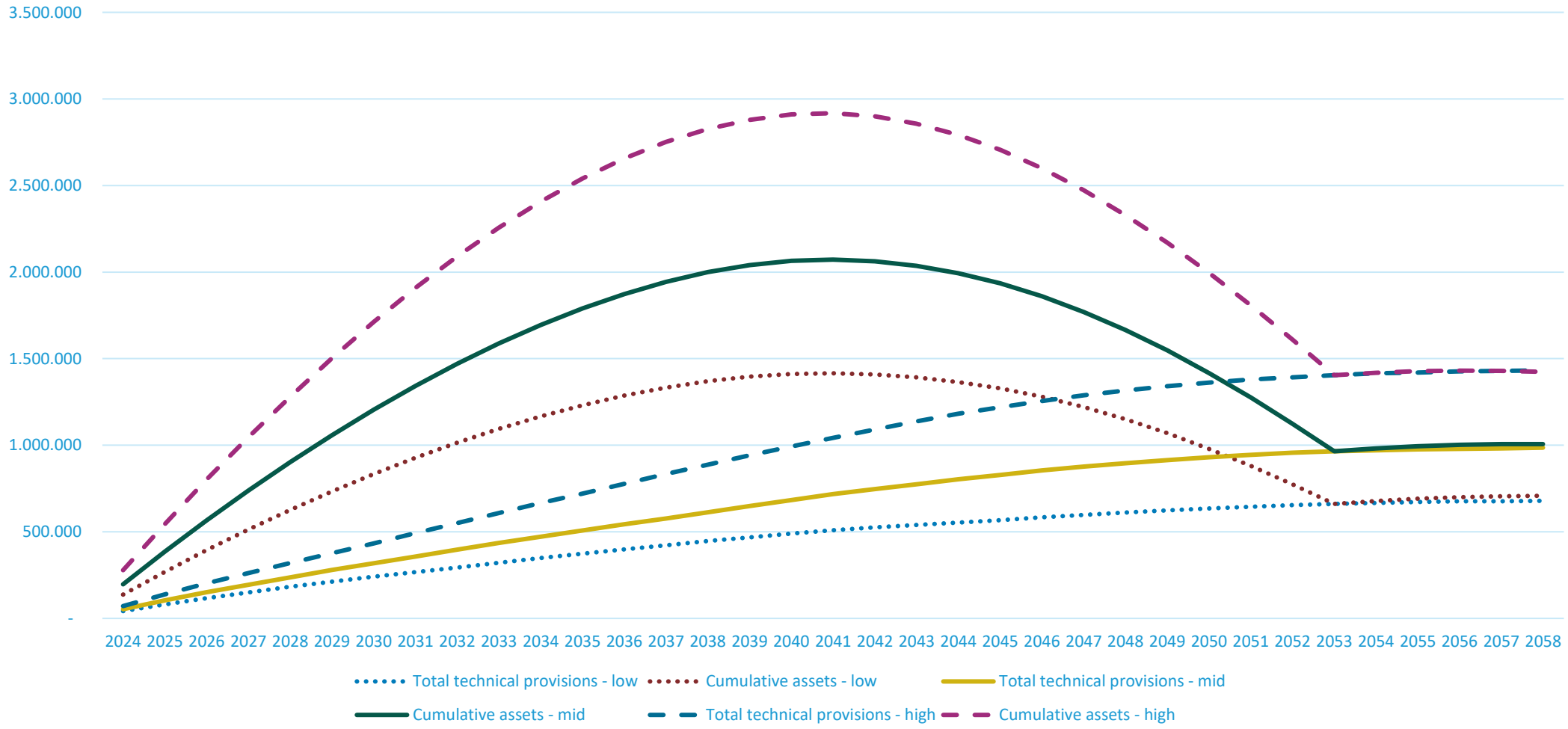
Simulation – «high scenario»

Fair premium per worker in t_1 (2024): 289,54€ Fair premium per worker in t_{31} (2054): 520,07€.

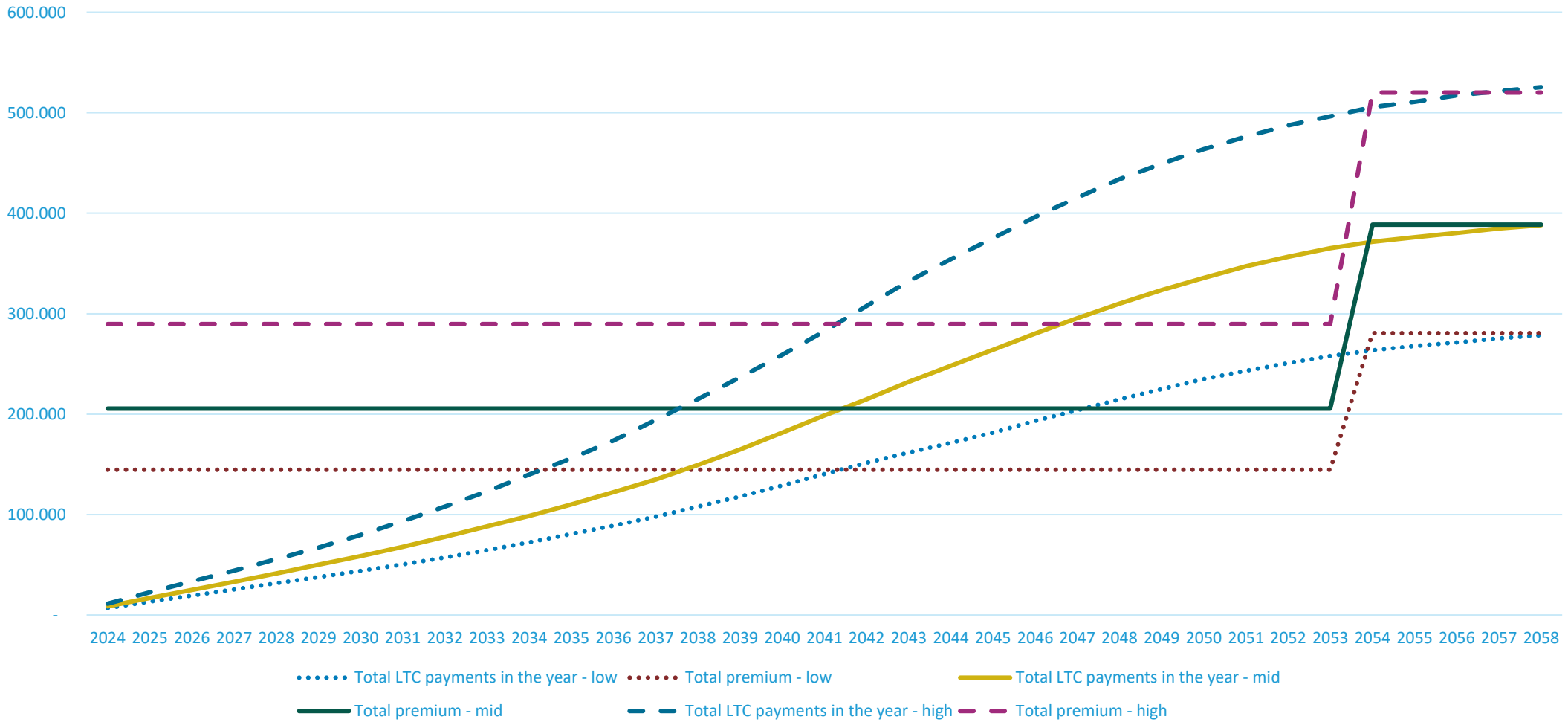
Year	Number of workers	Number of retirees	average age of workers + retirees	New LTC from workers	New LTC from retirees	Cumulative total number of LTC	Total technical provisions (k/€)	Total LTC payments in the year (k/€)	Total premium (k/€)	Cumulative assets (k/€)
2023	1,000,000	-	44.9	-	-	-	-	-	-	-
2024	1,000,000	19,768	45.5	939.3	-	939.3	70,911	11,272	289,539	278,268
2025	1,000,000	39,076	46.1	975.5	86.6	1,880.0	138,313	22,560	289,539	545,247
2026	1,000,000	58,892	46.6	972.2	255.9	2,780.9	201,399	33,371	289,539	801,415
2027	1,000,000	79,195	47.1	993.2	503.6	3,683.2	260,889	44,198	289,539	1,046,756
2028	1,000,000	98,972	47.6	1,014.4	866.7	4,626.7	319,018	55,520	289,539	1,280,775
…	…	…	…	…	…	…	…	…	…	…
2033	1,000,000	198,753	49.9	1,121.7	4,348.5	10,257.5	607,846	123,090	289,539	2,257,615
…	…	…	…	…	…	…	…	…	…	…
2038	1,000,000	292,369	51.8	1,134.6	10,903.9	17,913.2	887,795	214,958	289,539	2,826,783
…	…	…	…	…	…	…	…	…	…	…
2043	1,000,000	378,399	53.0	1,185.2	20,113.1	27,689.6	1,137,184	332,275	289,539	2,856,578
…	…	…	…	…	…	…	…	…	…	…
2048	1,000,000	428,459	53.8	1,139.1	28,431.5	36,151.8	1,316,329	433,822	289,539	2,329,212
…	…	…	…	…	…	…	…	…	…	…
2053	1,000,000	443,771	54.5	1,132.2	33,590.2	41,377.4	**1,403,883**	496,529	289,539	**1,403,883**
2054	1,000,000	444,058	54.6	1,114.9	34,331.9	42,142.1	1,415,077	505,705	520,071	1,418,249
2055	1,000,000	442,670	54.7	1,110.2	34,760.8	42,578.8	1,420,016	510,946	520,071	1,427,374
2056	1,000,000	440,458	54.8	1,134.5	35,239.5	43,098.1	1,426,789	517,177	520,071	1,430,268
2057	1,000,000	437,626	54.9	1,132.3	35,574.6	43,468.8	1,429,785	521,626	520,071	1,428,713
2058	1,000,000	435,020	55.0	1,161.9	35,864.5	43,802.3	1,432,779	525,628	520,071	1,423,157

First 30 years

Simulation – Results



Simulation – Results



ALM

- **Assumptions**

  - Consider only the (technical) mid scenario. The others follow straightforwardly.
  - Consider a 30 years' time horizon.
  - Consider the following different investment scenarios:

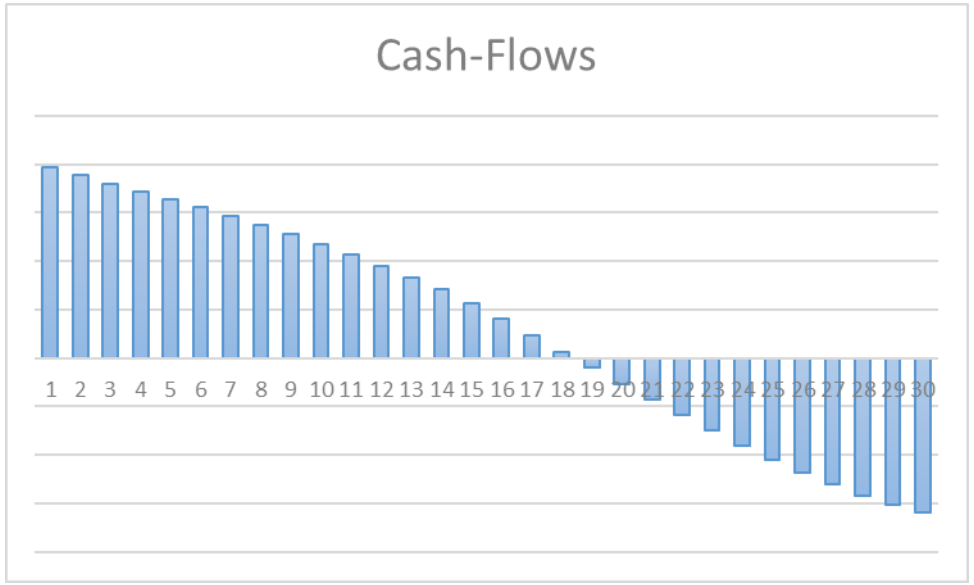
"Zero"
No investments, as in the previous analysis

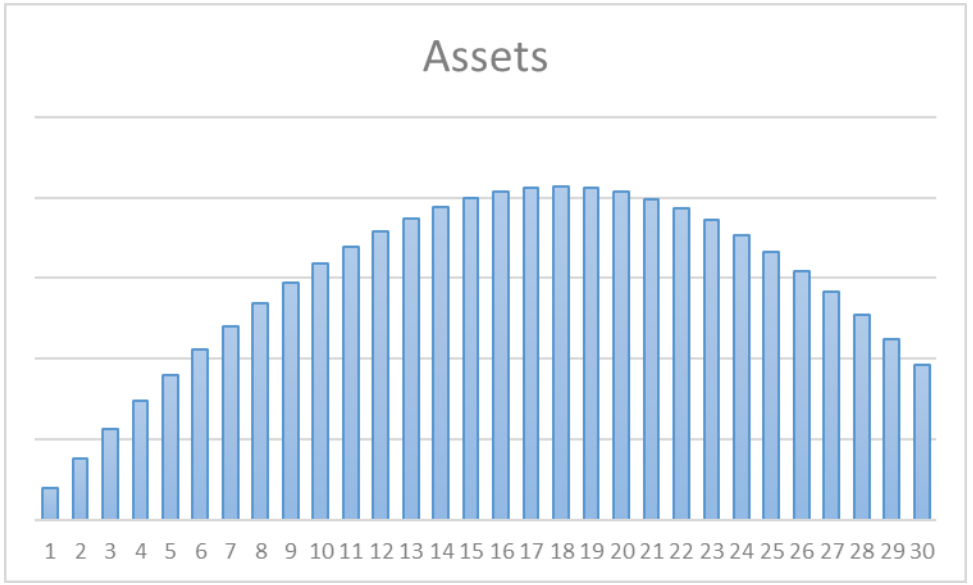
"Insurance"
Investment in insurance policies

"Portfolio"
Investment in market assets

"Zero"

This is not a realistic scenario. We can consider it as the technical analysis scenario for any further comparison.



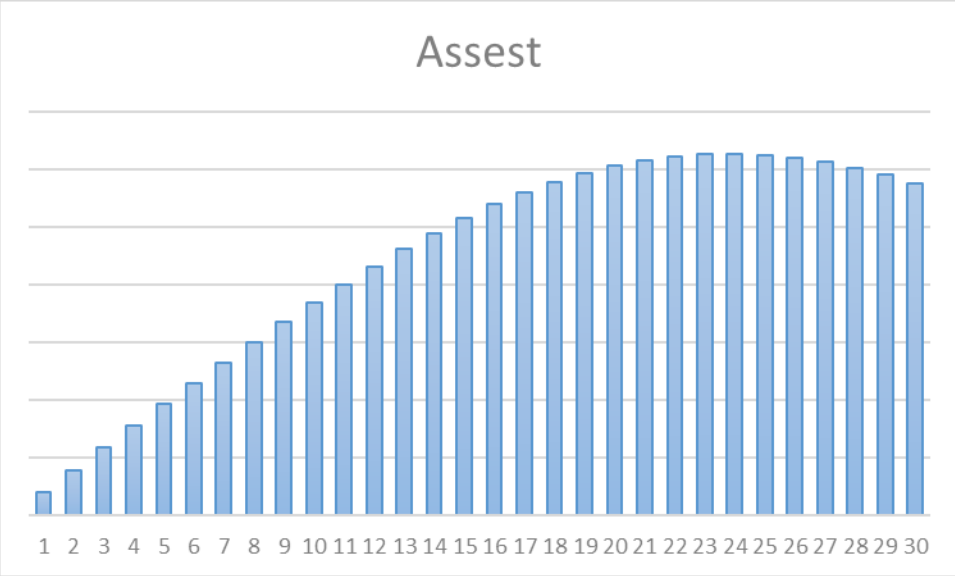


"Insurance"

In Italy, many supplementary health funds have only an insurance management.

Let us suppose a flat 3% annual return.

The insurance investment does not assure an improvement of the (pure) cash-flows.



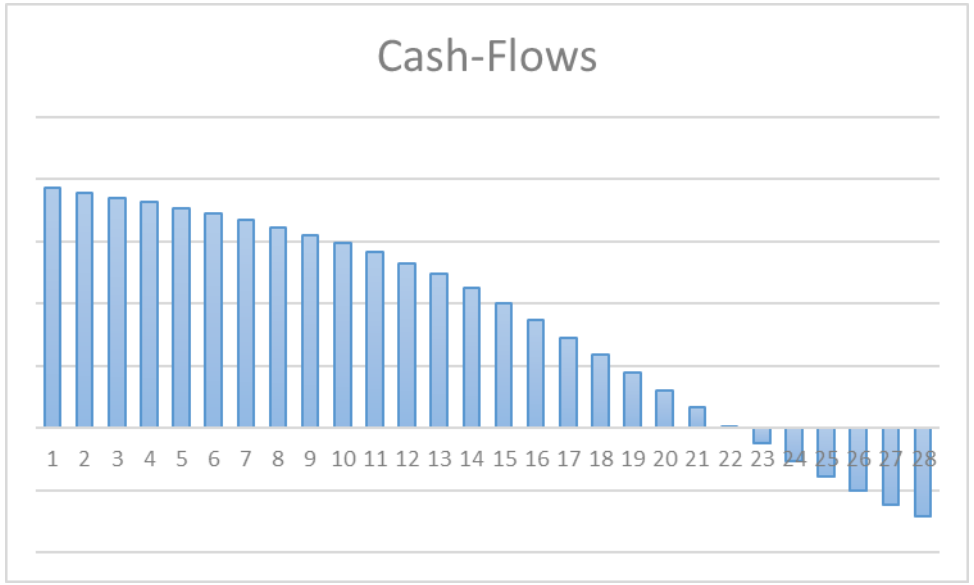
"Portfolio"

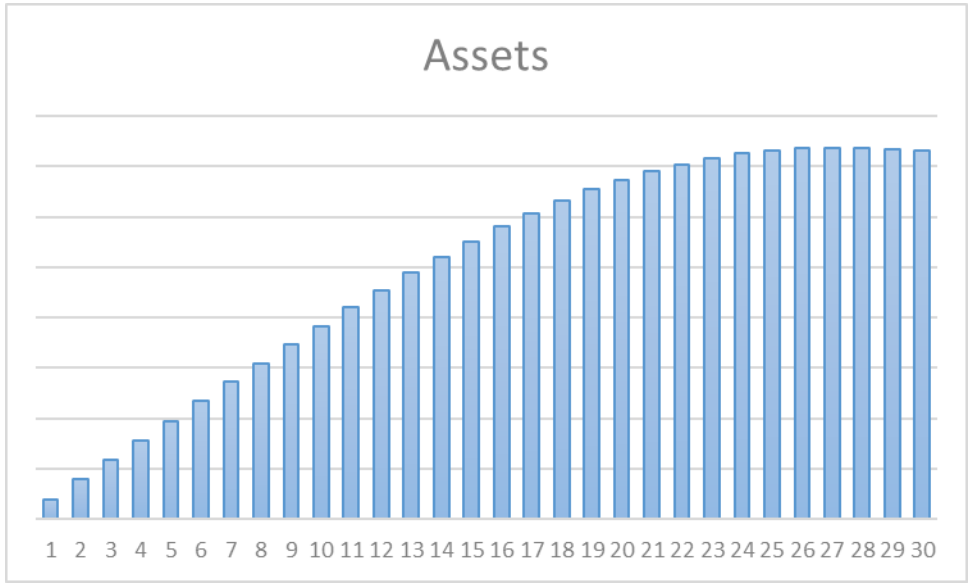
Suppose we can invest in the following assets with the specified target weight.

Asset	Expected return	Volatility	Target weight
Short term Italian gov bonds	2.08%	2.71%	30%
7-10y European gov bonds	3.76%	4.78%	15%
7-10y European corp bonds	3.98%	5.02%	20%
High yields	4.22%	6.51%	10%
Global equity	5.97%	14.67%	15%
Private equity	8.08%	8.99%	5%
Commodities	1.45%	11.15%	5%

"Portfolio"

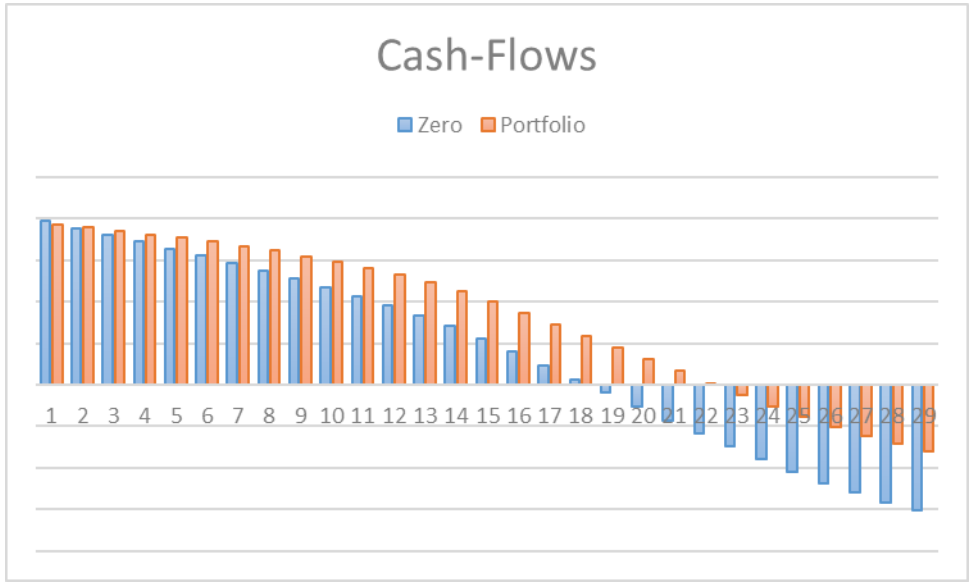
In this scenario, we have a significant different evolution of cash-flows and assets.

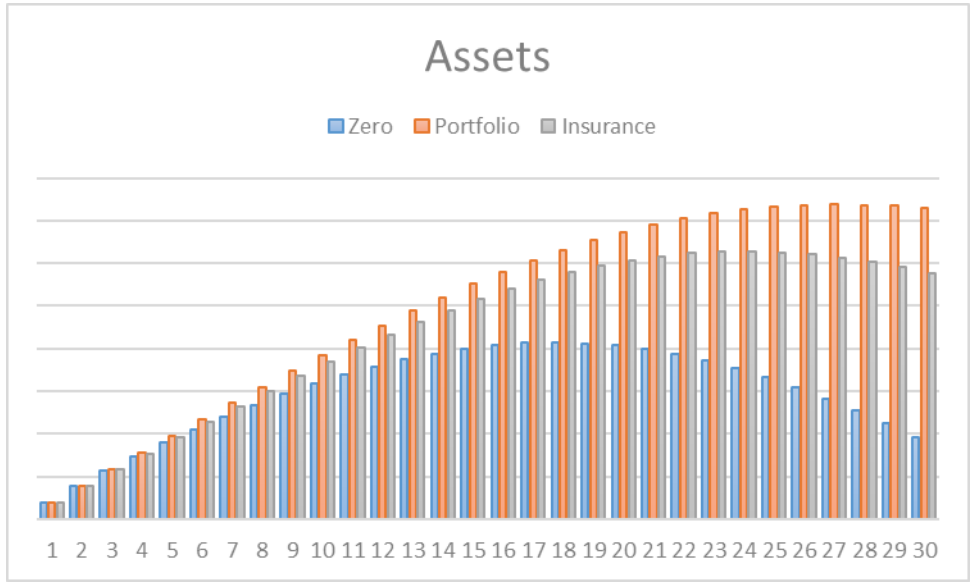




Let us compare

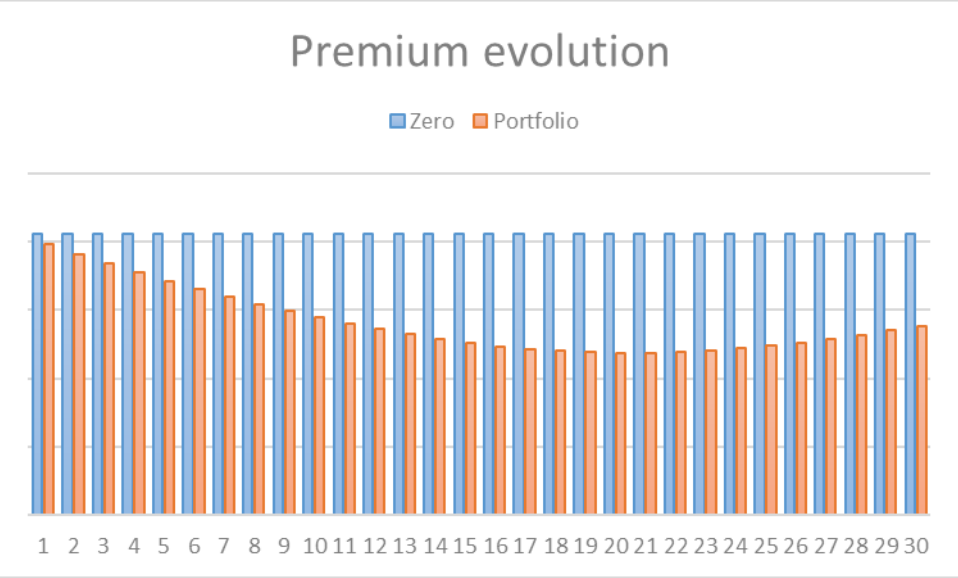
Comparison of the three scenarios.





Further analysis 1

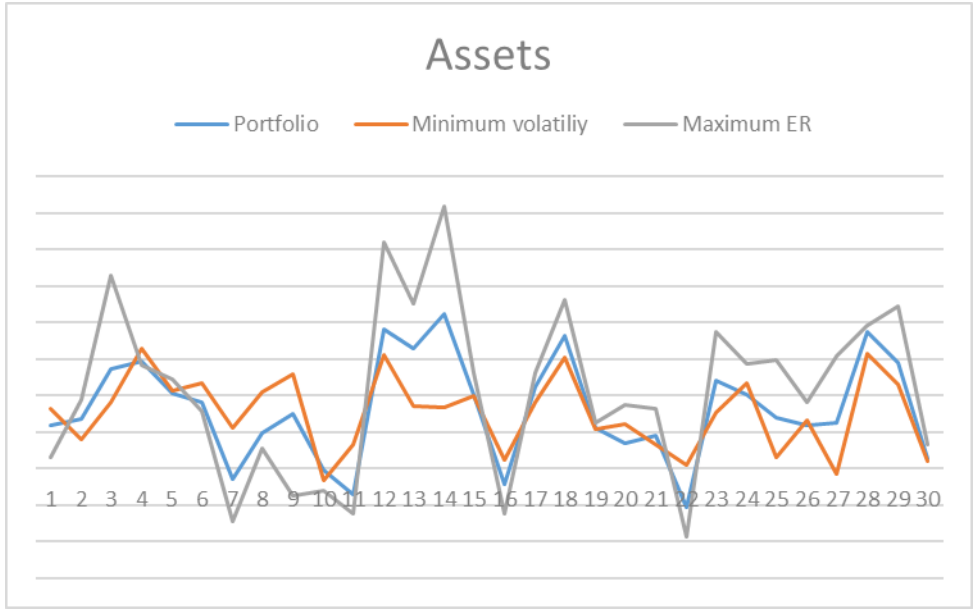
(Theoretical) Premium adjustment exploiting the profit of the "Portfolio" investment.



After 20 years the minimum is reached (118.54 vs 205.46); after, the raise of the annuities exceeds the financial returns.

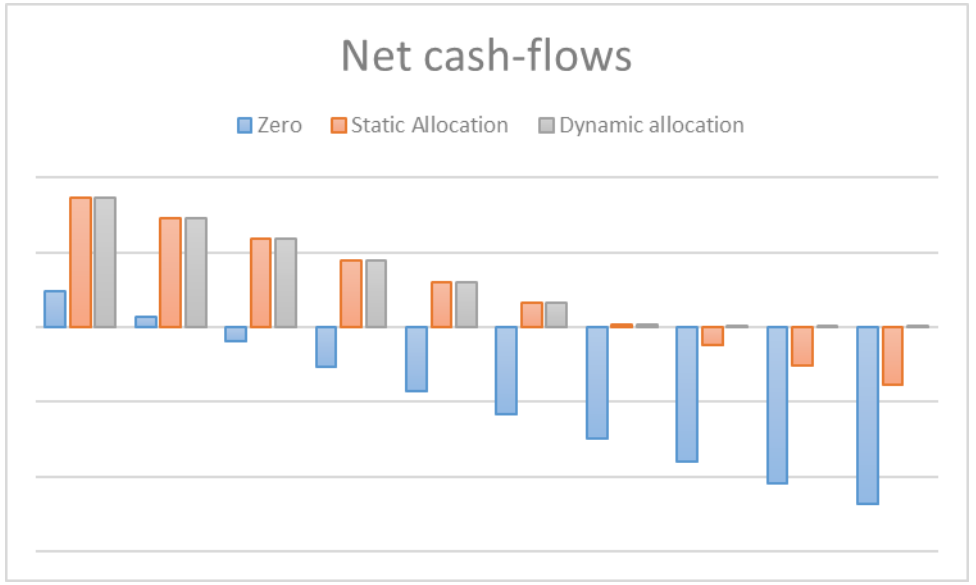
Further analysis 2

Stochastic approach (Monte-Carlo simulation). Here, a single path simulated considering the defined allocation, the minimum volatility and the maximum expected return allocations, supposing "reasonable" limits.



Further analysis 3

Build a ALM approach to assure, with high probability, to cover the liabilities. Modify the asset allocation to optimize the cashflows. Here the same stochastic simulation of the previous slide (compared to the zero scenario) assuming dynamic and static allocation (ten years period highlighted).



Conclusions

To ensure a long-term sustainability and adequacy:

- Different definitions of non-self-sufficiency can lower or raise the frequencies.
- Consider in the model discontinuous careers and contribution gaps.
- Evaluate possible insurance coverage also for family members.
- Define an optimized asset allocation, coherent with the out-flows.
- Build a strong ALM model, to guarantee positive cash-flows and an adequate risk/return profile.
- Consider the proper model to ensure the best estimation of the future evolution of the variables and parameters.
- Repeat the whole analysis with a proper periodicity.

Thank you

Contact Details

v.marchisio@studio-cea.it

a.desisto@studio-cea.it