INSTITUTO SUPERIOR DE ECONOMIA E GESTÃO

MASTERS FINAL WORK

PROJECT

The Case of Netherlands' Bouwen & Pensioen: Rethinking Pension Investing

Author:

António M. J. PEREIRA

A thesis submitted in fulfillment of the requirements

for the degree of Master's in Finance

Lisbon, 15th of October 2022

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Glossary

Active Members – A pension fund member actively building up pension.

Age Group – set of members grouped by age in a given year.

Deferred Member – A pension fund member entitled to a payment in the future (example: members who no longer work in the sector).

Generation – set of members born in the same year

Initial Work Age – age by which a person starts working and becomes an Active Member of the pension fund.

Maximum Age – Maximum age allowed by the model. Assumption that from this age onwards, the person no longer belongs to the Pension Fund.

Pensioners – A pension Fund member who is receiving his/hers pension benefits, no longer contributing actively to the fund.

Abbreviations

C - Contributions

B – Pension Benefits

CAC – Collective Asset Account

CETV – Cash Equivalent Transfer Value

CPVL – Collective Present Value of Liabilities

FFR – Final Funding Ratio

IAC – Individual Asset Account

NB – Net Benefits

S – Salary (usually associated to a generation and year)

SSE – Sum of Squared Residuals

TFR – Target Funding Ratio

Abstract, Keywords and JEL Codes

This paper analyses the challenges posed by the low-yield environment and aging population on pension funds asset management. A newly-created, fictional collective defined contribution pension fund is presented, *Bouwen & Pensioen*, being the result of the merger of 6 smaller defined benefit funds. Cash equivalent transfer values for each member are calculated and it is found that the new pension fund faces a deficit funding ratio. A forecasting model for the operations of *Bouwen & Pensioen* is derived. Tests are conducted on relevant variables using the derived model. A proposal is made to the newly-created pension fund regarding the solidarity reserve mechanism and the investment strategy to follow. The proposals allow *Bouwen & Pensioen* to attain a 100% funding ratio by the end of the forecasted period, keeping the flow of pension payments equitable and fair across generations.

KEY WORDS: low-yields, aging population, pension funds, solidarity reserve, investment strategy

JEL CODES: C30, C41, C51, C61, C63, E44, E47, J10

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1. INTRODUCTION

In September 2021, the McGill University launched the 5th edition of the McGill Portfolio Challenge. This edition's topic was on the challenges posed by the ultra-low-yield environment in pension fund asset management, challenging participants to rethink pension investing and to find solutions that would allow pension funds to attain adequate returns, keeping risk under control. For that purpose, a fictional pension fund *Bouwen & Pensioen,* was presented as well as the respective base assumptions for the case solution.

Bouwen & Pensioen, a newly formed Dutch pension fund for the construction sector begins operations in January 2022. The pension fund faces a series of industry-wide challenges that came into effect in the past decade, namely, aging population and the low-yield environment. Such challenges led to a necessary reformulation of pension plans that were highly dependent on returns from low risk, fixed income instruments, now yielding much lower returns mainly due to world-wide macroeconomic expansionary policies. *Bouwen & Pensioen* is thus a result of such reformulation, merging six smaller defined benefit plans into a single collective defined contribution plan. The pension fund is set to manage a portfolio of assets worth €30 Billion for 300'000 members from the construction sector. Given the low-yield environment and aging population affecting the pension fund sector in the past decade, we estimate that *Bouwen & Pensioen* faces a funding ratio of 68.74%. Such deficit level implies a necessary *aircut* on pensions paid. The challenge is thus deconstructed into two main goals: 1) To maximize pensions paid in an equitable and stable manner and 2) To ensure long-term financial viability of the pension fund. In order to achieve such goals, we first need to model the pension fund operations for a defined forecasted period. Within the pension fund structure of operations, two key parameters will be subject of deep analysis: the solidarity reserve and the portfolio investment strategy. Finally, we set to advice *Bouwen & Pensioen* on an investment strategy and solidarity reserve mechanism that will guide the pension fund to a safe ground financial level.

2. MARKET REVIEW

2.1. Macroeconomic Outlook

The background for this MFW starts with the 2008 financial crisis that led to historical macroeconomic expansionary policies through the lowering of interest rates and quantitative easing policies. The low interest-rate environment experienced in the first few years of the 2010-2020 decade posed significant threats to how pension funds could manage its operations. In 2020, following the outbreak of the COVID-19 pandemic, governments around the world, still managing the issue of low-interest rates, were forced to lower rates even further and inject liquidity through all-time records stimulus packages in an attempt to fight the inertia out of the global economy that had just faced a temporary total shutdown. These COVID-19 stimulus packages on top of the already low interest rate environment prior to the pandemic, bundled up to form a perfect storm for insurers and pension funds around the world (Pereira, Wang, 2022). Pension Funds end up being influenced by the low-yield environment namely through:

i. The substantial increase in the liabilities (reduction in rates increases the present value of future obligations), which in turn leads to a reduction in the funding ratio.
ii. Reduction of the universe of viable financial products due to the low returns of fixed income products.
iii. Necessary search-for-yield with increase of the portfolio share invested in risky assets.

Aside for the low-yield environment, pension asset managers are now facing a long-time coming problem: the impacts of an ageing population on the operational capabilities of pension funds. The ever-increasing life-expectancy coupled with low fertility rates are posing a serious challenge for pensions management due to the reduction of the share of labor force on total population and consequently, the reduction of the number of active members in contrast with the growing number of pensioners.

Finally, as presented in the case handout, portfolios of assets with considerable exposures to Dutch-coastal real-estate investments should be subject of review. In addition to the defense presented in the handout, several Dutch sea level specialists highlight the relevance of a national-wide plan of coastline withdrawal (Schuttenhelm, 2019) as the fight against rising sea levels is no longer in the hands of the people of The Netherlands. Rising sea-levels also pose uncertainty for the path of the Construction Sector: on one hand, it seems inevitable the reduction of available construction plots; on the other hand, forced withdrawal from the coastline would mean that infrastructures might have to be reallocated. As so, while the rising-sea level pose a market-wide threat for investments with exposures to coastal line real estate, a case could be made that it also poses a specific threat to *Bouwen & Pensioen* due to higher uncertainty on the construction sector and thus uncertainty on the future age-distribution of its members.

2.2. The 3-Pillar Pension System

The Netherlands assumes the role of leading example in pension system management (Westerhout, 2020). Pension payments rely on 3-Pillar-type pensions:

i. First Pillar: AOW Pension – *Algemene Ouderdomswet,* or National Old Age Pensions Act, represents the base pension for all individuals who have worked or lived on the Netherlands. Its pension level is not income-linked but rather longevity dependent, i.e., linked to the number of years a given individual paid social security contributions.
ii. Second Pillar: Comprised of semi-mandatory supplementary pensions, many times referred as workplace pensions and/or occupational pensions. Are usually supported by both the employer and employee who contribute a portion of the employee gross salary to a collective pension agreement. Usually the portion contributed by the employer is seen as an extra compensation side from the gross salary. For instance, in the case of *Bouwen & Pensioen*, it is assumed that the pension is paid equally between employee and employer, where the employer contribution is an extra deferred compensation on top of the employee gross salary.
iii. Third Pillar: Consisting of private, individual voluntary savings.

Despite the many decades of robust results, the Dutch pension system has faced high pressure from several market constraints in the last decade[1]. Most importantly, due to the ever-increasing ageing population coupled with decreasing active members, either due to a slowdown in fertility rates or by the increasing number of freelance workers. The low-yield environment also poses a major constraint since it required pension funds to hold a higher portion of capital due to solvency requirements forcing many funds to reduce their pension payments since many could not bring funding ratios to their minimal benchmark (Westerhout 2020). This pressure on the most reliable pension system in the world lead the Dutch Government to plan a reform with high focus for the second-pillar pension, which is also the focus of the present case-study: to analyse and interpret a model for pension fund management with sensitivity tests on the relevant variables.

2.3. Pension Schemes

In the world of Pension Funds there are 3 major pension schemes: Defined Benefit, Defined Contribution and Collective Defined Contribution.

In Defined Benefit (DB) plans, the amount of pension paid is linked to the longevity of an individual in the pension fund and hers/his respective contributions. The most common sub-type of scheme under Defined Benefit is average pay (Westerhout, 2020) where pensioners are paid accordingly to their career-average pay (specifics on the average calculation method are usually variable among pension contracts). Alternatively, and commonly used prior to the financial crisis of 2008-2009, there are also the final-salary defined benefit pension schemes. These schemes aim to pay a given percentage of the pensioners final salary during hers/his pension years. DB schemes may also feature conditional indexation, where entitlements for pensioners are indexed by inflation and/or sector-wage growth[1]. This type of feature, however, is most times conditional to the pension fund performance.

Defined Contribution (DC) plans, instead of promising a fixed percentage of either final/average salary, simply collect contributions during the members career, apply those contributions in financial markets and upon retirement distribute them in the form

[1] The Dutch pension system: highlights and characteristics (2019)

of a periodic pension payment. Defined Contribution Schemes (CDC), also mentioned in the literature as hybrid schemes, are most famously used in the Netherlands and combine features of both DB and DC plans. Usually, pension payments are based on the number of years and contributions to the plan. However, if the compounded contributions end up not being enough to fulfil the targeted pension payment level, pension benefits will be adjusted.

Regarding risk allocation, in DB pension plans, the pension fund bears the risk since it is bound to pay a fixed portion of the members salary upon retirement. In DC and CDC schemes, the pension fund member is the one bearing the risk since its benefits are dependent on the pension fund performance during hers/his life cycle.

Defined Benefits plans are the most commonly available pension schemes, where, as of 2018, average-wage DB schemes accounted for up to 91.8% of total pension schemes in the Netherlands (Westerhout, 2020). Despite its market dominance, a 2020 survey from Pensions Europe (2020). highlights a global market shift from defined benefit to defined contribution and collective defined contribution plans.

3. METHODOLOGY

One of the main features of this study is to develop a model that will act as a central tool on the analysis of the relevant variables. The proposed model is expected to accurately represent the operations of a Dutch pension fund, as the one presented in the McGill Portfolio Challenge. The assumptions taken by the case study handout are:

- A1. €30 Billion invested in different assets
- A2. Created to support over 300'000 pensioners
- A3. Fixed contribution rate for the period in study
- A4. Target pension benefit equal to 70% of final salary
- A5. Retirement age at 61y
- A6. Collective reserve capped at 15%
- A7. Salary Growth of 2.5% (as per McGill Excel handouts)

Since the model is expected to fully represent the operations of the pension fund, an account will be created for each generation of the 300'000 Pensioners. The base age distribution of the pensioners is assumed to be the same as the Dutch Population, while the forecasted age distribution is based on the current mortality tables. Data on these two variables was collected from the United Nations.[2] More details on the age structure of the pension in section 4. The proposed model represents all the financial operations of the pension fund described above with focus on the relations between assets and liabilities. Sensitivity tests will be conducted taking into consideration the relevant study variables. Since we are basing our model from real-world data, we are only able to forecast the age distribution evolution of generations already born in 2021. Thus, the time frame of forecast is restricted to the starting work age, i.e., we can only forecast the number of years a newborn in 2021 takes to start her/his professional career. In our case, since we assume that an individual starts working at the age of 20, we are able to model 21 years into the future, starting by the current year of 2021. Important to note that all of the assumptions above can easily be changed, i.e., the model is flexible and easily allows for a change of any of the above-mentioned inputs.

[2] United Nations – Department of Economic and Social Affairs (2022)

3.1. Cash Equivalent Transfer Values

In order to properly analyze the challenges ahead for *Bouwen & Pensioen,* first we need to fully grasp the current financial situation of the pension fund, namely by evaluating its assets and liabilities as of 2021 given the information provided. We already know that *Bouwen* assets are valued at €30 billion and so all we need to compute are the collective pension fund liabilities. The liabilities of a pension fund are described as present value of its future obligations (Blake 2006). There are 2 main approaches regarding the discount rate chosen: 1) Actuarial method and 2) Economical method. The economical method choice of discount rate relies on the risk-free rate. The actuarial method chooses as discount rate the past or projected future investment performance of the pension fund portfolio. For our analysis we will follow more closely the actuarial method rather than the economical method. The reasoning for this approach lies on the fact that we want to calculate the Cash Equivalent Transfer Value (CETV) for each of the members and given the different initial inputs for each generation (initial salary, inflation path), we expect the required rate of return to vary across generations. In practical terms we want to derive the Individual Asset Account (IAC) of each member in 2021 that allows them to reach the goal of 70% final-salary-pension upon retirement. For this approach, in addition to the assumptions presented by the case hand-out, we had to take a few more:

- B1. The Initial Work Age of each person is 20y, i.e., the age of entrance into the Pension Fund is 20y for every member.
- B2. Every individual will face a career longevity of 41y.
- B3. The age distribution of the Pension Fund members can be represented as a random sample of the Dutch population (i.e., *Bouwen* age structure mimics the Dutch population age distribution). In chapter 4 we will go deeper on the analysis of the current and forecasted age distribution.
- B4. The Maximum Age is set as 85y, i.e., we assume that any pensioner aged 85y will exit the Pension Fund the following year (Life expectancy on the Netherlands is 81y, as of 2020[3]).
- B5. Forecasted Inflation of 2% (target assumed by the ECB[4]).

[3] WorldBank (2022). Life Expectancy at Birth.
[4] European Central Bank (n.d.). Monetary Policy.

B6. Real Salary Growth assumed to be 0.5%. The basis for this assumption lies on the general case assumption of forecasted 2.5% nominal salary growth rate. From this assumption and our own assumption for forecasted inflation of 2%, we can derive the implied Real Salary growth rate of 0.5%. This assumption holds for both historical and forecasted periods.

$$Real\ Salary\ Growth = Nominal\ Growth - Inflation \tag{1}$$

B7. Initial Starting Salary of 33’000€ as of 2021, equivalent to 15.86€ per hour, assuming 40 hourly week (gross value within parameters from the European Federation of Building and Woodworkers[5])

B8. Average Contribution Rate of 24.70%. In this case, we assume the 12.35% contribution presented by the European Federation of Building and Woodworkers[2] to represent 50% of the contributions to the Pension Fund. The remaining 50% to be contributed by the employer company.

B9. AOW State Pension of 14’554 € as of 2021[7].

B10. Both AOW Pension and gross salary are adjusted yearly by the respective inflation level [6].

B11. Risk-free return assumed to be equal to the inflation rate (We define the risk-free rate as the return on inflation-linked bonds. Since we forecast inflation to be equal to 2%, inflation-linked bonds and thus, the risk-free were also assumed to return 2%).

B12. Target Pension Benefits indexed to inflation – we do not promise pension benefits indexed to inflation but we do use it as our target.

With all the assumptions drawn, we are now able to derive IAC for each generation in 2021. Our model builds a full-time horizon schedule for each of the pension fund generations. The schedule is composed by:

i. Salary of individual from generation g in period t ($S_{g,t}$).

ii. Contributions made *à priori* by individual of generation g ($C_{g,t}$) in period t *(à priori* meaning beginning of period).

[5] Construction Workers – Wages and Working Conditions. *European Federation of Building and Woodworkers.*

[6] Inflation, consumer prices (annual %). *WorldBank (2022).*

iii. Benefits paid *à priori* to an individual from generation g ($B_{g,t}$) in period t.

iv. Returns of the Individual Asset Account of individual from generation g in period $t-1$ ($R_{g,t-1}$), where,

$$R_{g,t-1} = R_g^{RR} * IAC_{g,t-1} \tag{2}$$

where R_g^{RR} stands for required return rate.

v. Individual Asset Account of individual from generation g in period t defined as ($IAC_{g,t}$), where

$$IAC_{g,t} = \begin{cases} IAC_{g,t-1} + C_{g,t} - B_{g,t} + R_{g,t-1} & , \quad if\ age < ma \\ 0 & , \quad if\ age = ma \end{cases} \tag{3}$$

where, ma stands for *maximum age*, assumed to be 85y.

Important to reinforce that we are considering that Contributions / Benefits for a given year are realized in the beginning of that same period (*à priori*).

In order to evaluate IAC for each generation, we will first need to derive the pensionable salary at the initial work age for each of the generations. According to PME Pensioen[7], pensionable salary ($PS_{g,t}$) is defined as the difference between gross salary and AOW pension (AOW_t):

$$PS_{g,t} = S_{g,t} - AOW_t \tag{4}$$

From this, we can derive the Contributions to be made each period:

$$C_{g,t} = PS_{g,t} * cr \tag{5}$$

where, cr stands for contribution rate, defined as the percentage contributed periodically by an individual to hers/his pension plan.

As a final step for this stage, we need to calculate the Benefits to be paid in each period. Pension benefits for each period are defined as the inflation adjusted target pension level:

$$B_{g,t} = \begin{cases} tpb * S_{g,t-1} & , \quad if\ t = retirement\ age \\ B_{g,t-1} * (1 + i_t) & , \quad if\ t > retirement\ age \end{cases} \tag{6}$$

[7] PME Pensioen (n.d.). *Premie, overige kerncijfers en rekenvoorbeelden.*

where, tpb stands for target pension benefit at retirement age, assumed to be 70% of final salary, and i_t stands for inflation rate for period t.

With all the variables mapped, we now have all the inputs to calculate IAC of each generation. By setting IAC as described above (*3*), our goal is to find the Required Rate of Return (R_g^{RR}) that compounds life-time individual contributions in order to build an individual account capable of paying each member the desired (target) pension level. In other words, we want to derive the required return that helds $IAC_{g,t=ma} = 0$. This problem is solved via a python optimization algorithm similar to Goal Seek of excel. In this case, we set the following optimization problem:

$$\min_{R_g^{RR}} IAC_{g,t=\text{ma}} \tag{7}$$

$$s.t.:$$

$$IAC_{g,t=ma} \geq 0$$

Relevant to point out that, given the different demographic and economical statistics for which each generation is exposed through its life-cycle (namely inflation - impacting salaries - , age distribution and mortality rates), each generation will have a different required rate of return, making this a computational-expensive optimization. Having found the array for required rate of returns, we can now sketch the individual schedule for each of the generations, where the Individual Asset Account for the year of 2021 will be used as the CETV.

Table 1 - Individual Schedule for person from generation 70y (Short version)

Generation 70 (70y in 2021)								
Age	**Year**	**Salary**	**Contributions**	**Benefits**	**Return %**	**Absolute Returns**	**IAC**	**AOW**
20	1971	€ 7 050,03	€ 973,37	€ -	-	€ -	€ 973,37	€ 3 109,28
21	1972	€ 7 612,46	€ 1 054,86	€ -	3,5510%	€ 34,56	€ 2 062,79	€ 3 341,78
22	1973	€ 8 244,50	€ 1 146,57	€ -	3,5510%	€ 73,25	€ 3 282,60	€ 3 602,53
...	...	...	...	...	...	...	...	...
65	2016		€ -	€ 12 293,58	3,5510%	€ 7 843,55	€ 216 432,90	€ 13 537,35
66	2017		€ -	€ 12 767,33	3,5510%	€ 7 685,53	€ 211 351,11	€ 13 580,21
67	2018		€ -	€ 13 106,67	3,5510%	€ 7 505,08	€ 205 749,52	€ 13 767,82
68	2019		€ -	€ 13 409,63	3,5510%	€ 7 306,17	€ 199 646,06	€ 14 002,35
69	2020		€ -	€ 13 589,09	3,5510%	€ 7 089,43	€ 193 146,40	€ 14 371,13
70	2021		€ -	€ 13 965,43	3,5510%	€ 6 858,63	€ **186 039,61**	€ 14 554,00
71	2022		€ -	€ 14 244,73	3,5510%	€ 6 606,27	€ 178 401,14	€ 14 845,08
72	2023		€ -	€ 14 529,63	3,5510%	€ 6 335,03	€ 170 206,54	€ 15 141,98
73	2024		€ -	€ 14 820,22	3,5510%	€ 6 044,04	€ 161 430,35	€ 15 444,82
74	2025		€ -	€ 15 116,63	3,5510%	€ 5 732,39	€ 152 046,12	€ 15 753,72
75	2026		€ -	€ 15 418,96	3,5510%	€ 5 399,16	€ 142 026,32	€ 16 068,79
...	...	...	...	...	...	...	...	...
83	2034		€ -	€ 18 065,77	3,5510%	€ 1 830,16	€ 35 303,73	€ 18 827,15
84	2035		€ -	€ 18 427,08	3,5510%	€ 1 253,64	€ 18 130,28	€ 19 203,69
85	2036		€ -	€ 18 795,62	3,5510%	€ 643,81	-€ 21,53	€ 19 587,77

Table 1 depicts the individual schedule for an individual belonging to generation 70, i.e., an individual aged 70y as of 2021. As we can see, $R_{g=70}^{RR} = 3.5510\%$ and $IAC_{g=70,t=70} = 186'039.61$ which will be our CETV for any individual from generation 70 in 2021. For a full example of a schedule of generation 20, please refer to Table 6 in the appendix. Since the supra-mentioned tables were built using the required rate of return that helds members preferences upon retirement, we can refer to IAC as a target individual asset account ($TIAC_{g,t}$), since it is the implied value that an individual should have in 2021 in order to attain 70% of final salary as pension payments for hers /his retirement period. With this in mind, we can convert the individual data into a collective dataframe fetching all the individual values for the year 2021 for each generation:

Table 2 – Aggregate Data (short version)

Aggregate Data 2021						
Generation	**# Members**	**TIAC**	**Salary**	**Benefits**	**RRR**	**CPVL (Thousands)**
0	3943	€ -	€ -	€ -	3,2079%	€ -
1	3838	€ -	€ -	€ -	3,2079%	€ -
2	3806	€ -	€ -	€ -	3,2079%	€ -
3	3835	€ -	€ -	€ -	3,2079%	€ -
4	3901	€ -	€ -	€ -	3,2079%	€ -
5	3935	€ -	€ -	€ -	3,2079%	€ -
...	...	...	...	...	...	...
25	4927	€ 29 020,47	€ 33 821,21	€ -	3,2188%	€ 142 983,83
26	5007	€ 34 368,35	€ 33 989,31	€ -	3,2166%	€ 172 082,32
27	5079	€ 39 871,85	€ 34 157,62	€ -	3,2134%	€ 202 509,13
28	5119	€ 45 451,90	€ 34 324,23	€ -	3,2106%	€ 232 668,28
29	5184	€ 51 116,55	€ 34 491,73	€ -	3,2082%	€ 264 988,18
30	5207	€ 56 872,52	€ 34 660,25	€ -	3,2060%	€ 296 135,23
...	...	...	...	...	...	...
55	5650	€ 239 285,78	€ 39 171,56	€ -	3,1585%	€ 1 351 964,68
56	5729	€ 248 339,47	€ 39 363,09	€ -	3,1550%	€ 1 422 736,83
57	5717	€ 257 461,90	€ 39 553,62	€ -	3,1525%	€ 1 471 909,65
58	5600	€ 266 713,44	€ 39 746,11	€ -	3,1506%	€ 1 493 595,29
59	5503	€ 275 916,56	€ 39 933,75	€ -	3,1514%	€ 1 518 368,85
60	5377	€ 282 690,56	€ 40 120,81	€ -	3,1121%	€ 1 520 027,15
...	...	...	...	...	...	...
80	2359	€ 65 613,49		€ 13 907,81	4,0028%	€ 154 782,23
81	2235	€ 52 575,91		€ 13 807,62	4,0350%	€ 117 507,15
82	2051	€ 39 647,57		€ 13 761,65	4,0838%	€ 81 317,16
83	1841	€ 26 689,38		€ 13 770,39	4,1490%	€ 49 135,15
84	1640	€ 13 439,92		€ 13 737,69	4,2056%	€ 22 041,48
85	1470	-€ 21,34		€ 13 749,13	4,2759%	-€ 31,37

For the full-length data, please refer to Table 7 in the appendix.

From the results presented above, we can calculate the Collective Present Value of Liabilities of *Bouwen & Pensioen*:

$$CPVL_{2021} = \sum_{g=0}^{g=ma} TIAC_{g,t=0} * NM_{g,t=0} \tag{8}$$

where $NM_{g,t}$ stands for the number of members of generation g at period t.

From the assumptions presented in the case hand-out, we have that the current Collective Asset Account is defined as:

A.1. $CAC_{2021} = 30\ B€\ (Billion\ euros)$

And, as we just calculated in the table, we have our first pre-model result (R.1.),

R.1. $CPVL_{2021} = 43\ B€\ (Billion\ euros)$

Assuming a desired funding ratio of 100%, *Bouwen & Pensioen* asset structure should held a 1:1 ratio between collective assets and collective liabilities. We can calculate the initial funding ratio (IFR) as:

R.2. $IFR = \frac{CAC_{2021}}{CPVL_{2021}} = 68.74\%$

This is an important result: it tells us that *Bouwen & Pensioen* is facing severe solvency problems. As portrayed by Westerhout (2020) *Bouwen* is not alone in its struggle. From the 900 active pension funds in 2009, only 200 remained in 2019. A possible solution to avoid the worst-case scenario would be an adjustment to current and future payments, as many other pension funds were forced to do.

Since *Bouwen & Pensioen* is moving into a CDC scheme, we propose an initial setting for the newly founded CDC plan composed by two macro-components:

i. Collective Reserve Account – with initial allocation of 15% of total assets. To be used as intergenerational buffer with pension-maximization and pension-stabilization goals (more on this on Chapter 4).
ii. Individual Asset Account – for the individual component of the new CDC plan, we propose an *aircut* applied on the target individual asset accounts. The *aircut* should compromise not only the funding ratio adjustment but also the initial allocation to the reserve. We will enter in more detail on this topic in the section 5.

3.2. The Forecasting Model

For this section, we will fetch variables derived in section 3.1. and assume them as target values for the forecasted period by adding the prefix T to each one:

$$IAC_{g,t} \Rightarrow TIAC_{g,t}$$

$$B_{g,t} \Rightarrow TB_{g,t}$$

With all the initial inputs derived, we can now start building the proposed forecasted operational model for the pension fund. Here, the model will follow some of the characteristics of the previous model described in section 3.1., with the additions of portfolio returns, solidarity reserve and all the remaining necessary adjustments to incorporate these two components.

For this model, in addition to the assumptions made before in A1-A7 and B1-B12, we will need to take a few more:

- C1. First operational of *Bouwen & Pensioen* is 2022, however since we need a base to start with, we will depart from 2021, assuming the old structure of defined benefit pension schemes for this year.
- C2. Forecasting Period of 20y + base year (until 2041).
- C3. Forecasted Age Distribution based on data demographics data from the United Nations[2] (More detail in section 4).
- C4. Full Benefits as previously scheduled will be paid in the first operational year.
- C5. Initial Reserve set as 15% of Total Assets.
- C6. Returns Contribution Rate for the Reserve (defined as the contribution rate of positive returns) initially set as 10% (to be subject of testing further ahead).
- C7. Reserve to be fully invested in the market (reasoning for this in section 5)
- C8. No uncertainty on labor income
- C9. Base scenario assuming Market Returns of 6% and Corporate Bonds returning 4% (more detail on this in section 6.)

We start by defining our goal: to maximize pensions paid while keeping volatility of pensions low and funding ratios at healthy levels. To do so, we asked ourselves a few relevant questions:

i. How can we improve pension payments given the current funding deficit of *Bouwen & Pensioen*?
ii. How can we structure a Portfolio Management Strategy that allows higher pension payments keeping volatility low?

In order to answer these questions, we first need to build our base model. We will build an individual-20y-forecasting-schedule for each of the generations, considering the following variables:

i. Salary of generation g at period t ($S_{g,t}$) - no change from the previous model
ii. Contributions made *à priori* by each individual from generation g in period t ($C_{g,t}$) - no change from the previous model
iii. Benefits paid *à priori* to each individual from generation g in period t ($B_{g,t}$), now defined as:

$$B_{g,t} = \begin{cases} tpb * S_{g,t-1} * \prod_{T=t-(a_{g,t}-ra)}^{T=t} (1+i_T)\,, & if\ t=0 \\ NB_{g,t} + RF_{g,t} & , \ if\ t>0 \end{cases} \tag{9}$$

where, $NB_{g,t}$ stands for net benefit of generation g at period t, $RF_{g,t}$ stands for reserve flow of generation g at period t and $a_{g,t}$ stands for age of generation g at period t

The term on the first bracket simply represents the target pension benefit at period t compounded by inflation, which represents the target pension benefit of each individual for the base year. i.e., for the first year (2021) we will pay full benefits to pensioners as scheduled by the previous pension schemes. Further adjustments will only happen in subsequent years. In turn, Net Benefit is defined by applying a growing annuity formula valuation such as,

$$NB_{g,t} = \frac{IAC_{g,t-1} * (R^D_{g,t} - i_t)}{1 - \left(\frac{1 + i_t}{1 + R^D_{g,t}}\right)^{ma - a_{g,t} + 1}} \quad (10)$$

where, $R^D_{g,t}$ stands for discount rate for generation g at period t. Intuitively, we are setting the Net Benefit as the yearly payment for which the present value of all Net Benefits paid from period t until the last membership year (when ma is reached) equals the individual asset account at period t. Since we are assuming that pension benefits grow by the inflation rate, we will take it as the growth factor in the growing annuity formula. And once we are using the actuarial method to discount future benefits, we calculated the expected geometric average return until maximum aged is reached, assuming a portfolio management strategy to be described in section 6 and base asset class returns as defined in C.9. and B.11. As for the Reserve flow, we will detail its calculation method in section 5.

iv. Returns of the Individual Asset Account ($R_{g,t}$) – detailed explanation in section 5.

v. Individual Asset Account ($IAC_{g,t}$), now defined as,

$$IAC_{g,t} = \begin{cases} TIAC_{g,t} * \text{IFR} * (1 - sra) & , \ if\ t = 0 \\ IAC_{g,t-1} + C_{g,t} - B_{g,t} + R_{g,t-1} * (1 - rcr), & if\ t > 0 \end{cases} \quad (11)$$

where sra stands for solidarity reserve adjustment and rcr stands for return contribution rate for the reserve. For $t = 0$, we set the individual asset account as a direct adjustment of the Initial Funding Ratio, as calculated in (R.2.). We also make an adjustment due to the creation of the collective reserve account and here we assume contributions to be equally spread between members, i.e., every member contributes the same percentage of hers/his initial endowment.

For examples of 20y-individual-shchedules, please refer to Table 3 and Table 4 below. Please note that the results in the above-mentioned tables are set as a function of portfolio returns which follow assumptions C.7. and C.9..

Table 3 - Forecasted schedule for generation 20

Generation 20 (20y in 2021)											
Age	Year	Salary	Contributions	AOW	Net Benefits	Reserve Flow	Total Benefits	Target Benefits	Returns	IAC	TIAC
20	2021	€ 33 000,00	€ 4 556,16	€ 14 554,00	€ -	€ -	€ -	€ -	€ -	€ 2 348,76	€ 4 556,16
21	2022	€ 33 825,00	€ 4 688,04	€ 14 845,08	€ -	€ -	€ -	€ -	€ 119,79	€ 7 156,59	€ 9 445,90
22	2023	€ 34 670,63	€ 4 823,57	€ 15 141,98	€ -	€ -	€ -	€ -	€ 364,99	€ 12 345,15	€ 14 629,89
23	2024	€ 35 537,39	€ 4 962,86	€ 15 444,82	€ -	€ -	€ -	€ -	€ 629,60	€ 17 937,62	€ 20 121,40
24	2025	€ 36 425,83	€ 5 106,01	€ 15 753,72	€ -	€ -	€ -	€ -	€ 914,82	€ 23 958,45	€ 25 934,23
25	2026	€ 37 336,47	€ 5 253,12	€ 16 068,79	€ -	€ -	€ -	€ -	€ 1 221,88	€ 30 433,44	€ 32 082,69
26	2027	€ 38 269,88	€ 5 404,29	€ 16 390,17	€ -	€ -	€ -	€ -	€ 1 552,11	€ 37 389,84	€ 38 581,70
27	2028	€ 39 226,63	€ 5 559,64	€ 16 717,97	€ -	€ -	€ -	€ -	€ 1 906,88	€ 44 856,36	€ 45 446,76
28	2029	€ 40 207,30	€ 5 719,28	€ 17 052,33	€ -	€ -	€ -	€ -	€ 2 287,67	€ 52 863,31	€ 52 693,96
29	2030	€ 41 212,48	€ 5 883,32	€ 17 393,38	€ -	€ -	€ -	€ -	€ 2 696,03	€ 61 442,66	€ 60 340,05
30	2031	€ 42 242,79	€ 6 051,88	€ 17 741,24	€ -	€ -	€ -	€ -	€ 3 133,58	€ 70 628,11	€ 68 402,44
31	2032	€ 43 298,86	€ 6 225,09	€ 18 096,07	€ -	€ -	€ -	€ -	€ 3 602,03	€ 80 455,24	€ 76 899,19
32	2033	€ 44 381,33	€ 6 403,07	€ 18 457,99	€ -	€ -	€ -	€ -	€ 4 103,22	€ 90 961,52	€ 85 849,10
33	2034	€ 45 490,86	€ 6 585,94	€ 18 827,15	€ -	€ -	€ -	€ -	€ 4 639,04	€ 102 186,49	€ 95 271,70
34	2035	€ 46 628,14	€ 6 773,84	€ 19 203,69	€ -	€ -	€ -	€ -	€ 5 211,51	€ 114 171,84	€ 105 187,26
35	2036	€ 47 793,84	€ 6 966,90	€ 19 587,77	€ -	€ -	€ -	€ -	€ 5 822,76	€ 126 961,51	€ 115 616,87
36	2037	€ 48 988,69	€ 7 165,26	€ 19 979,52	€ -	€ -	€ -	€ -	€ 6 475,04	€ 140 601,81	€ 126 582,40
37	2038	€ 50 213,40	€ 7 369,07	€ 20 379,11	€ -	€ -	€ -	€ -	€ 7 170,69	€ 155 141,57	€ 138 106,60
38	2039	€ 51 468,74	€ 7 578,46	€ 20 786,70	€ -	€ -	€ -	€ -	€ 7 912,22	€ 170 632,25	€ 150 213,08
39	2040	€ 52 755,46	€ 7 793,60	€ 21 202,43	€ -	€ -	€ -	€ -	€ 8 702,24	€ 187 128,09	€ 162 926,37
40	2041	€ 54 074,34	€ 8 014,62	€ 21 626,48	€ -	€ -	€ -	**€ -**	€ 9 543,53	€ 204 686,25	€ 176 271,94

Table 4 - Forecasted schedule for generation 50

Generation 50 (50y in 2021)											
Age	Year	Salary	Contributions	AOW	Net Benefits	Reserve Flow	Total Benefits	Target Benefits	Returns	IAC	TIAC
50	2021	€ 38 213,61	€ 5 843,92	€ 14 554,00	€ -	€ -	€ -	€ -	€ -	€ 101 362,62	€ 196 624,68
51	2022	€ 39 168,95	€ 6 008,00	€ 14 845,08	€ -	€ -	€ -	€ -	€ 4 050,31	€ 111 420,93	€ 208 912,41
52	2023	€ 40 148,17	€ 6 176,53	€ 15 141,98	€ -	€ -	€ -	€ -	€ 4 312,59	€ 121 910,05	€ 221 758,73
53	2024	€ 41 151,88	€ 6 349,64	€ 15 444,82	€ -	€ -	€ -	€ -	€ 4 587,26	€ 132 846,95	€ 235 185,91
54	2025	€ 42 180,67	€ 6 527,46	€ 15 753,72	€ -	€ -	€ -	€ -	€ 4 874,90	€ 144 249,30	€ 249 217,06
55	2026	€ 43 235,19	€ 6 710,10	€ 16 068,79	€ -	€ -	€ -	€ -	€ 5 176,12	€ 156 135,53	€ 263 876,14
56	2027	€ 44 316,07	€ 6 897,70	€ 16 390,17	€ -	€ -	€ -	€ -	€ 5 491,58	€ 168 524,80	€ 279 188,00
57	2028	€ 45 423,97	€ 7 090,38	€ 16 717,97	€ -	€ -	€ -	€ -	€ 5 821,93	€ 181 437,11	€ 295 178,40
58	2029	€ 46 559,57	€ 7 288,29	€ 17 052,33	€ -	€ -	€ -	€ -	€ 5 911,74	€ 194 637,15	€ 311 874,08
59	2030	€ 47 723,56	€ 7 491,56	€ 17 393,38	€ -	€ -	€ -	€ -	€ 6 093,14	€ 208 221,84	€ 329 302,71
60	2031	€ 48 916,65	€ 7 700,33	€ 17 741,24	€ -	€ -	€ -	€ -	€ 6 277,03	€ 222 199,20	€ 347 493,04
61	2032	€ -	€ -	€ 18 096,07	€ 10 839,48	€ 1 632,61	€ 12 472,09	€ 16 371,32	€ 6 463,35	€ 217 823,06	€ 342 107,13
62	2033	€ -	€ -	€ 18 457,99	€ 10 969,23	€ 1 528,80	€ 12 498,03	€ 16 698,75	€ 6 292,73	€ 213 146,57	€ 336 223,53
63	2034	€ -	€ -	€ 18 827,15	€ 11 099,16	€ 1 450,43	€ 12 549,59	€ 17 032,72	€ 6 111,47	€ 208 158,87	€ 329 819,95
64	2035	€ -	€ -	€ 19 203,69	€ 11 229,11	€ 1 399,18	€ 12 628,29	€ 17 373,38	€ 5 919,18	€ 202 848,94	€ 322 873,28
65	2036	€ -	€ -	€ 19 587,77	€ 11 358,90	€ 1 374,57	€ 12 733,46	€ 17 720,84	€ 5 715,47	€ 197 205,52	€ 315 359,53
66	2037	€ -	€ -	€ 19 979,52	€ 11 488,29	€ 1 380,81	€ 12 869,10	€ 18 075,26	€ 5 499,97	€ 191 217,20	€ 307 253,83
67	2038	€ -	€ -	€ 20 379,11	€ 11 617,04	€ 1 407,59	€ 13 024,63	€ 18 436,76	€ 5 272,27	€ 184 872,42	€ 298 530,38
68	2039	€ -	€ -	€ 20 786,70	€ 11 744,85	€ 1 454,54	€ 13 199,39	€ 18 805,50	€ 5 031,96	€ 178 159,54	€ 289 162,42
69	2040	€ -	€ -	€ 21 202,43	€ 11 871,33	€ 1 524,58	€ 13 395,91	€ 19 181,61	€ 4 778,65	€ 171 066,85	€ 279 122,19
70	2041	€ -	€ -	€ 21 626,48	€ 11 996,07	€ 1 613,16	€ 13 609,23	**€ 19 565,24**	€ 4 511,92	€ 163 582,71	€ 268 380,93

After deriving a 20y-schecule for each the of the generations, we can represent the data collectively by multiplying each generation account by its number of members in the respective year and summing horizontally. All variables, except for the Collective Reserve Account are simple horizontal sums as given by:

$$CAC_t = \sum_{g=0}^{g=ma} IAC_{g,t} * NM_{g,t} \quad (12)$$

$$CPVL_t = \sum_{g=0}^{g=ma} TIAC_{g,t} * NM_{g,t} \tag{13}$$

where, $NM_{g,t}$ stands for the number of members of generation g at period t. Relevant to point out that the Target Individual Asset Account ($TIAC_{g,t}$) is also representative of the Present Value of Liabilities for generation *g* at period *t* since it represents the necessary endowment that each individual at any given point in time should have in order to attain hers/his desired benefits level upon retirement.

Since there is no individual component to the reserve account (we only have individual flows to/from the reserve), we need to derive the formulation for it. In our case, the Collective Reserve Account will be positively affected by the contributions made by active members and negatively affected by the outflows to pensioners. Full explanation on the mechanics of the solidarity reserve will be detailed in Section 5. As so, the Solidarity Reserve at period t (SR_t) can be described as,

$$SR_t = \begin{cases} CAC_t * sra & ,if\ t = 0 \\ SR_{t-1} + \sum_{g=0}^{g=ma} R_{g,t-1} * rcr - RF_{g,t} & ,if\ t > 0 \end{cases} \tag{14}$$

Finally, we add as variable the Funding Ratio of period t given by,

$$FR_t = \frac{CAC_t}{CPVL_t} \tag{15}$$

With all the variables drawn, we can now output the 20y-collective-schedule for the forecasted period. In sections 4 and 5 we will further analyze the results.

Table 5 - Collective Acounts (Values in Million €, expect for the number of members, in absolute terms)

Collective Accounts								
Year	**# Members**	**CAC**	**CPVL**	**Reserve**	**Reserve Outflow**	**Reserve Inflow**	**Total Returns**	**FR**
2021	300000	€ 30 000,000	€ 43 645,825	€ 7 500,000	€ -	€ -	€ -	68,735%
2022	301122	€ 31 369,513	€ 44 610,780	€ 7 752,887	€ 197,141	€ 0,028	€ 450,000	70,318%
2023	302244	€ 32 315,754	€ 45 587,592	€ 7 531,625	€ 686,465	€ 0,030	€ 465,173	70,887%
2024	303308	€ 33 266,962	€ 46 570,675	€ 7 266,715	€ 716,839	€ 0,031	€ 451,898	71,433%
2025	304270	€ 34 238,480	€ 47 553,768	€ 6 976,080	€ 726,672	€ 0,033	€ 436,003	72,000%
2026	305170	€ 35 266,930	€ 48 533,479	€ 6 697,072	€ 697,608	€ 0,035	€ 418,565	72,665%
2027	306085	€ 36 352,302	€ 49 508,587	€ 6 429,226	€ 669,707	€ 0,037	€ 401,824	73,426%
2028	307044	€ 37 494,886	€ 50 478,181	€ 6 172,096	€ 642,923	€ 0,039	€ 385,754	74,279%
2029	307946	€ 38 694,565	€ 51 441,917	€ 5 925,253	€ 617,210	€ 0,041	€ 370,326	75,220%
2030	308732	€ 39 949,177	€ 52 396,104	€ 5 688,287	€ 592,525	€ 0,044	€ 355,515	76,245%
2031	309480	€ 41 255,273	€ 53 335,177	€ 5 460,801	€ 568,829	€ 0,046	€ 341,297	77,351%
2032	309751	€ 42 617,275	€ 54 266,301	€ 5 242,417	€ 546,080	€ 0,048	€ 327,648	78,534%
2033	309447	€ 44 041,302	€ 55 200,039	€ 5 032,772	€ 524,242	€ 0,051	€ 314,545	79,785%
2034	309246	€ 45 531,716	€ 56 140,544	€ 4 831,515	€ 503,277	€ 0,054	€ 301,966	81,103%
2035	309137	€ 47 092,232	€ 57 091,912	€ 4 638,311	€ 483,151	€ 0,057	€ 289,891	82,485%
2036	309033	€ 48 725,378	€ 58 056,220	€ 4 452,838	€ 463,831	€ 0,060	€ 278,299	83,928%
2037	308935	€ 50 431,764	€ 59 033,950	€ 4 274,787	€ 445,284	€ 0,063	€ 267,170	85,428%
2038	308701	€ 52 211,298	€ 60 025,985	€ 4 103,861	€ 427,479	€ 0,066	€ 256,487	86,981%
2039	308375	€ 54 062,873	€ 61 033,233	€ 3 939,776	€ 410,386	€ 0,069	€ 246,232	88,579%
2040	307999	€ 55 985,625	€ 62 056,793	€ 3 782,257	€ 393,978	€ 0,073	€ 236,387	90,217%
2041	307405	€ 57 975,480	€ 63 093,384	€ 3 631,043	€ 378,226	€ 0,076	€ 226,935	91,888%

4. DRAWING BOUWEN'S AGE STRUCTURE

In the two past decades, declining fertility rates combined with increasing life expectancy and falling infant mortality led to a sharp increase in the share of the elderly in the total population, which threatens the financial stability of pensions funds (Poterba 2014) by decreasing the number of active members and increasing the number of pensioners.

In order to correctly evaluate the state of the pension fund and the challenges ahead, our base model departs from the current age distribution of the general Dutch population and simulates future age structure of the pension fund members based on current mortality rates, estimated mortality rate growth rate and inflow of migrants.

$$NM_{i,t} = NM_{g,t-1} * MR_{g,t-1} * (1 + mrg)^t + IMI_i \quad (16)$$

where $NM_{i,t}$ stands for the number of members of generation g at period t, $MR_{g,t}$ stands for the mortality rate of generation g at period t, mrg stands for mortality rate growth rate and $IMI_{g,t}$ stands for the inflow of migrants of generation g at period t.

As a departure point, current age distribution (up until 2021) and mortality rate table (up until 2021) data were collected from the United Nations[2] database. We depart from the assumption that the current member base of *Bouwen & Pensioen* can be represented by a random sample of the Dutch population (in the sense that it embodies the same relevant statistics). An important note to be made here is that full size of the pension fund is of 300'000 members. We assume these members to be aged between the *initial work age* and the *maximum age* and thus, since we forecast the number of people aged 0 to *maximum age*, the full sample had to be adjusted to 383'402 people, of which 300'000 are members of the pension fund and 83'402 are considered to be future members of *Bouwen & Pensioen* (calculated via direct proportional adjustment).

Mortality rate growth rate assumed to be zero. The idea to incorporate this variable in the model departure from the premise of decreasing infant fatality rates and falling mortality rates as described by Poterba (2014). However, for the base model we will assume, for data consistency purposes, that Mortality tables will remain constant throw-out the forecasting period.

Inflow of migrants is assumed to be 100 people per generation aged between the starting work age and 40. The basis for this estimate relies on historical data from CBS[8] available in Table 9.

With all the assumptions drawn, we are now able to forecast the age structure of *Bouwen & Pensioen* for the upcoming 20 years, as exhibited in Tables 10 and 11. Relevant to note that we do not forecast birth rates and thus, are not able to forecast new births from 2021 onwards. Since we are focusing our analysis for a time period of 21 years, the age structure of people aged younger than 20y won't matter for the analysis. They are only sketched in order to build up future generations' forecasts. As an example, a person aged 5y in 2021 will be 25y in 2041 and thus an active member of the pension fund by then. The number of members aged 25y in 2041 can only be calculated by taking the number of people aged 5y in 2021 and applying yearly the general formula described in (16).

Proceeding with some analysis on the forecasted age structure, we are able to visualize the impact of ageing population on the age structure of *Bouwen & Pensioen* (Figure 1 below).

[8] Centraal Bureau voor de Statistiek (2022). Population; sex, age, generation and migration background.

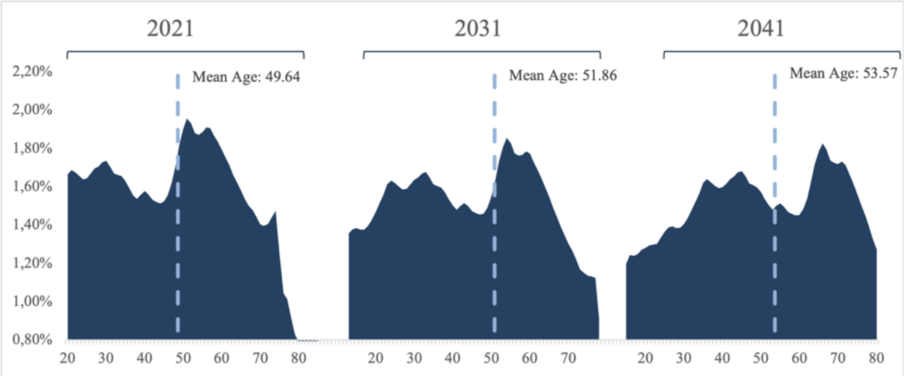


Figure 1 - Age Distribution without the effect of immigration

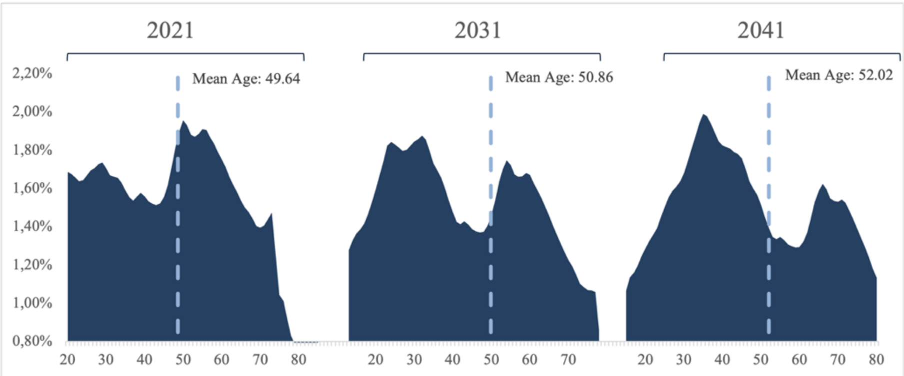


Figure 2 - Age Distribution with effect of immigration

Two group peaks can be identified in 2021: 1) people aged 20-35 and 2) people aged 50-65, with higher relevant for the latter. Analyzing the year of 2031 and 2041 (also by checking Table 10), we can infer that the number of new pension fund entrants is considerably lower as time goes by. An immediate and very important result from rightwards movement of the age distribution is the acceleration of the negative flow of active members, as described by the negatively slopped active members to pensioners ratio in Figure 3. As exhibited, without the effects of immigration, it is expected that the ratio of active members to pensioners to decrease from the current 2.2x to 1.53x. Such drastic evolution of the age structure of *Bouwen & Pensioen* poses one of the most challenging features of the present case study, given the initial pronounced deficit of the funding ratio.

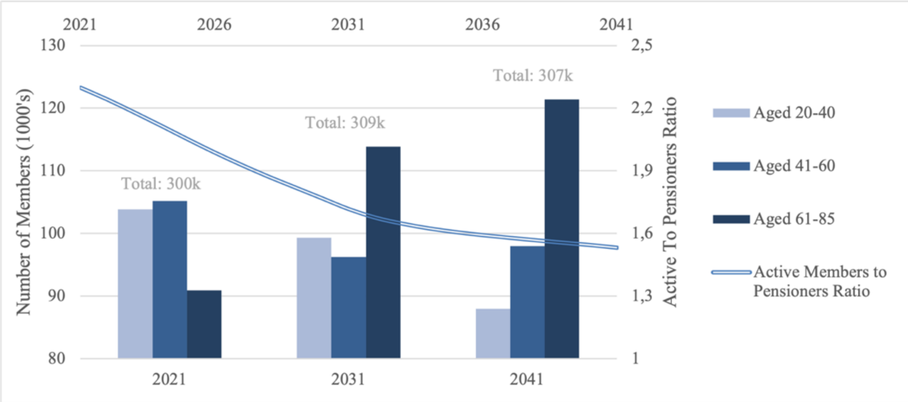


Figure 3 - Evolution of Active / Pensioner Members assuming no Immigration

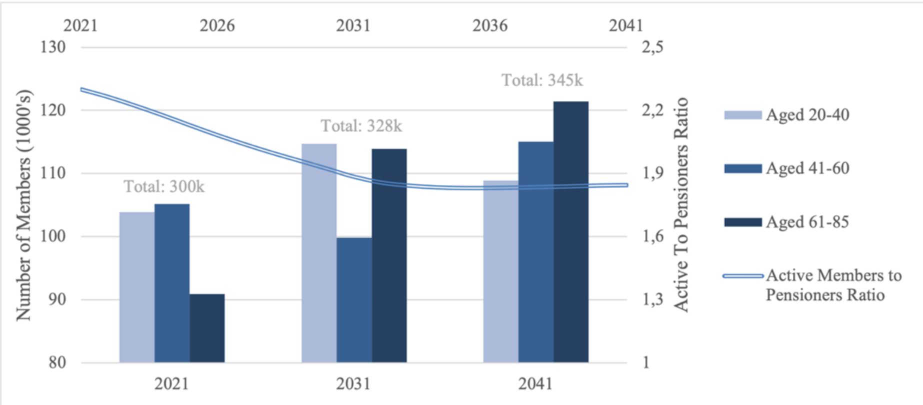


Figure 4 - Evolution of Active / Pensioner Members with Immigration

As already presented in Figures 3 and 4, Immigration plays a vital role in the long-term operations of *Bouwen & Pensioen* since it allows for an inflow of young workers that will rebalance the age structure of the pension. In fact, the number of active members is expected to increase by 20.38% in 2041 when comparing the same period in the absence of immigration, raising the active members to pensioners ratio to a more comfortable 1.84x. From the analysis of the active members to pensioners curve, in the case of immigration, it is possible to visualize an inflection point by 2035 (more evident with Figure 10 – Appendix) by when the relation of active members to pensioners is expected to reverse, resulting in a positive flow of active members from 2035 onwards. If considering reasonable values for migration influx, full effects of aging population won't ever be fully compensated but certainly mitigated, boosting the performance of the Pension Fund.

5. SOLIDARITY RESERVE

In our model, the solidarity reserve is comprised by an initial allocation, equal to 15% of initial assets, positively affected by inflows from contributions of active members as defined in (14) and negatively affected by distributions to pensioners. The latter feature of the Solidarity Reserve will be the one with higher focus in this section. Usually, the fundamental idea behind this mechanism is to allow for an intergenerational risk-sharing, many times described as an intergenerational buffer. However, in our model we aim to go a step further: we want the expand the mechanism behind the solidarity reserve in such a way that it allows us to slowly increase the funding ratio of the Pension Fund and to bring back pension payments closest to their target values. Although no longer required, *Bouwen & Pensioen* should aim at a target funding ratio of 100% in order to ensure the payment of pensions independently of the future behavior of exogenous factors such as aging population and a sector-specific labor force fluctuations.

As so, we choose to follow of a path by which outflows from the reserve are linked to the funding ratio of the pension fund. In this case, funds are distributed according to the gap between the actual and target funding ratios; the higher the gap, the higher the outflow from the reserve to a given pensioner. In order to apply this concept in our model, we would first need to define a target value for the funding ratio for any given year. Here, in a first approach, we picked a model in which we would assume a linear growth of the funding ratio from its current level until 100% is achieved. However, in our tests this would imply that a pensioner in 2021 facing a funding ratio of 68.74% would be subject to the same target funding ratio increase as a pensioner in, for example 2031 with an actual collective funding ratio for the pension fund of 70%. Given that a higher funding ratio leads to higher pension payments, *ceteris paribus*, it would seem unfair and sub-optimal to expose individuals in 2021 to the same target collective funding ratio increase as future generations with higher collective funding ratios since we aim at, not only increasing pension payments, but also to keep volatility of payments low. With all this in mind, we derived a target funding ratio growth model as described below:

$$gfr^s = \sqrt[\kappa]{\frac{TFR_{t=FFR}}{IFR_{t=0}}} \tag{17}$$

where gfr^s stands for static growth rate of the funding ratio, FFR stands for final funding ratio date, TFR_t stands for target value for the funding ratio at t and K stands for the number of steps by which gfr_s will be compounded until $2021 + FFR$. FFR is defined as the limit by which we want the TFR to be achieved. In our case we will departure from an $FFR = 50$, i.e., we will set the yearly TFR in such a way that a Funding Ratio of 100% is achieved by 2041 (2021+20y). An immediate result of this approach is that the lower the value for FFR, the lower the payments in the period defined until 2021+FFR. Given that we are looking for a model that allows for an acceleration in the growth rate of the funding ratio, we set as growth rate for a particular year the growth rate of the previous year compounded by gfr_t. For instance, for $gfr^s = 2\%$, we will have that in period $t = 1$, $gfr_{t=1} = 2\%$ and in period $t = 2$, $gfr_{t=2} = (1 + 2\%)^2 - 1$, for period t=3, $gfr_{t=3} = (1 + 2\%)^3 - 1$ and so on. With this in mind, we can right TFR_t as follows,

$$TFR_t = \begin{cases} FR_t * (1 + gfr^s) & , \quad if\ t = 0 \\ TFR_{t-1} * (1 + gfr_t) & , \quad if\ t > 0 \end{cases} \tag{18}$$

where,

$$gfr_t = (1 + gfr_s)^{t+1} - 1 \tag{19}$$

If $t = 0$, we set as target funding ratio the actual funding ratio compounded by the static funding ratio growth rate,

$$TFR_{t=0} = FR_{t=0} * (1 + gfr^s) \tag{20}$$

For $t = 1$, we will have that,

$$TFR_{t=1} = TFR_{t=0} * (1 + gfr_{t=1}) \tag{21}$$

Substituting for $TFR_{t=0}$ and $gfr_{t=1}$,

$$TFR_{t=1} = (FR_{t=0} * (1 + gfr^s)) * (1 + gfr^s)^2 \Leftrightarrow$$

$$\Leftrightarrow TFR_{t=1} = FR_{t=0} * (1 + gfr^s)^3 \tag{22}$$

For $t = 2$, we will have that,

$$TFR_{t=2} = TFR_1 * gfr_{t=2} \tag{23}$$

Substituting for $TFR_{t=1}$ and $gfr_{t=2}$,

$$TFR_{t=2} = (FR_{t=0} * (1 + gfr^s)^3 * (1 + gfr^s)^3 \Leftrightarrow$$

$$\Leftrightarrow TFR_{t=2} = FR_{t=0} * (1 + gfr^s)^6 \Leftrightarrow \tag{24}$$

Intuitively we can see that the number of steps that the static funding ratio growth rate is compounded follows a triangular sum and so, for $t = n$ we would have that,

$$TFR_{t=n} = FR_{t=0} * (1 + gfr_s)^{\frac{n*(n+1)}{2}} \tag{25}$$

Having derived the yearly collective target value for the funding ratio, we can now formulate the decision rule for the solidarity reserve withdraws. Given the current solvency issues of *Bouwen & Pensioen*, we consider to be of extreme importance the fulfillment of the target funding ratio for any given period (with a caveat for the first couple of years, to be introduced further ahead). In order to apply this reasoning in our model, we first need to calculate the target value for the collective asset account ($TCAC_t$),

$$TCAC_t = TFR_t * CPVL_t \tag{26}$$

I.e., we set as target collective asset account the adjusted value of the collective present value of future liabilities which represents the necessary asset account value for period t to enforce *Bouwen & Pensioen* to keep on track in order to attain the desired funding ratio of 100% by 2041. In practical terms, we can formulate withdrawals from the reserve account as the excess Collective Asset Account value over the Target Collective Asset Account, bounded by zero:

$$TRF_t = \; MIN\;(0, CAC_{t-1} - TCAC_{t-1}) \tag{27}$$

Important to note that the reserve withdrawals are always calculated based on the pension fund statistics of the previous period. This happens because we are assuming that pension payments/contributions are realized in the beginning of the period and already accounted for in the calculation of the collective accounts in our model schedules.

Having derived the reserve flows from the reserve at any given period, we now need to distribute the reserve flow through all pensioners in a fairly manner. As so, we set to minimize the sum of squared residuals between the actual pension paid and target pension level for each generation at each of the forecasted periods. We choose the sum of squared residuals as model to optimize our study variable since it is a model that penalizes heavier the results further from the desired level (target pension), which allows for a more equitable and fairer outcome. In order to apply this method, we will need the target pension level and net pension level for each period and each generation.

In section 3.1., we built an individual lifetime schedule for each of the current and future generations of *Bouwen & Pensioen*. While doing so we calculated the current and forecasted target pension benefits for each of the generations. We can now fetch those results for the forecasted period years, now defined as Target Pension Benefits ($TB_{g,t}$). In section 3.2., we derived the Net Benefit for each generation, which will also come into use in this section. Having both inputs in hand, we can now derive the reserve flow to each pensioner following the below optimization problem:

$$\min_{CRF_t} \sum_{g=ra}^{g=ma} \left(TB_{g,t} - B_{g,t}\right)^2 \tag{28}$$

where, CRF_t stands for collective reserve flow at period t

From the result derived in (9), we know that for t > 0 we have that,

$$B_{g,t} = NB_{g,t} + RF_{g,t}$$

Aggregating the reserve flows in a single array we can define CRF_t as

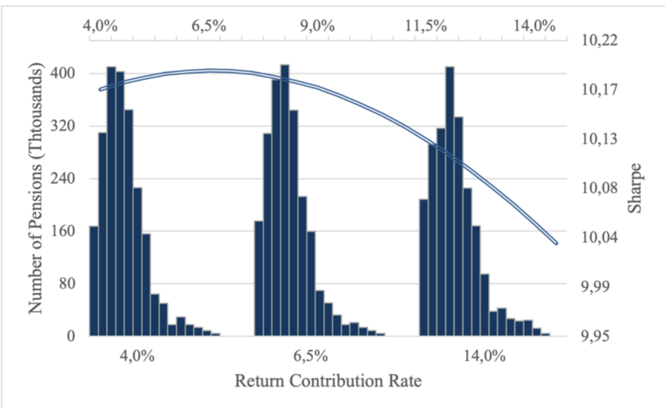
$$CRF_t = \begin{bmatrix} RF_{ra,t} \\ RF_{ra+1,t} \\ \dots \\ RF_{ma,t} \end{bmatrix} \tag{29}$$

Finally, after applying the optimization algorithm described in (28), we get the final results, to be presented in the results section of the paper.

Important to highlight that, since 1) we are working with a model that slowly increases its pension payments and 2) the first few years of operation are more exposed to market conditions (due to deficit starting level and less time of exposure to the new, higher-yielding investment strategy), in order to maintain a fair level of equity between generations, we set a minimum payout ratio from the reserve for the first 5 forecasted years. In order to choose the appropriate value for the minimum payout ratio, we conducted a sensitivity analysis, as exhibited in Figure 11 in the appendix. For this part we aim at maximizing the ratio between average pension and volatility, which we define by *Sharpe*. As we can see, Sharpe seems to have a quasi-logarithmical relationship with the minimum payout ratio, i.e., as we increase the minimum payout ratio, the tradeoff between average pension and volatility of pensions is positive with decreasing acceleration until the level of 9% is reached. At a minimum payout of 9%, we reach an inflection point. From that point onwards, increasing the minimum payout ratio leads to a decrease in Sharpe. The minimum payout ratio that results in the maximum *Sharpe* is at 4% and thus will be the level used from this point onwards.

Next, we set to define the optimal return contribution rate for the reserve. After conducting sensitivity analysis on this variable, we were able to derive the optimal level (defined as the one that results in the maximum Sharpe), of 6.5%. We can also see that as we increase the returns contribution rate, the concentration around the mean value decreases leading to fatter tails, characteristic of a less equitable and unfairer distribution for pension payments. Having to balance between optimality measured by Sharpe and fairness and equity measured by pensions distribution, we will stick with the 6.5% return contribution rate given the fact that the distributions for 4% and 6.5% return contribution rate are not that different (also measured by similar skew and kurtosis levels).

Figure 5 - Optimal level for return contribution rate to the reserve



6. PORTFOLIO MANAGEMENT

Regarding the challenge posed by low-yields, we tried to come up with a solution that would not only allow for a general higher exposure to risky assets but also a solution that wouldn't compromise pension payments and its volatility. We start by constructing 3 portfolios of assets varying on the risk level:

i. Portfolio A – Composed by the risk-free asset / index-linked bonds
ii. Portfolio B – Composed by Corporate Bonds
iii. Portfolio C – Composed by Stocks

We will also organize *Bouwen & Pensioen* assets accordingly to their liability's maturities:

i. Basket of Assets A ($BA_{A,t)}$– Equal to short-term liabilities due in 5y, discounted at the risk-free rate:

$$BA_{A,t} = \sum_{t=t+1}^{t=t+5} \sum_{age=ra}^{age=ma} TB_{age,t} \tag{30}$$

We then need to bound $BA_{A,t}$ to the Collective Asset Account,

$$BA_{A,t} = MIN(BA_{A,t}, CAC_t) \tag{31}$$

ii. Basket of Assets B – Equal medium-term liabilities due in the range of 5y-15y, discounted at the risk free

$$BA_{B,t} = \sum_{t=5+1}^{t=t+15} \sum_{age=ra}^{age=ma} TB_{age,t} \tag{32}$$

Again, we need to bound $BA_{B,t}$ to the remaining Collective Asset Account,

$$BA_{B,t} = MIN(BA_{B,t}, CAC_t - BA_{A,t}) \tag{33}$$

iii. Basket of Assets C – Described as the remaining available assets, as a proxy for long-term liabilities,

$$BA_{C,t} = MAX(CAC_t - BA_{A,t} - BA_{B,t}, 0) \tag{34}$$

With the Basket of Assets and Portfolio of Assets defined we propose the following investment strategy:

i. Fully invest Basket of Assets A in Portfolio A – we propose short-term liabilities to be fully covered by highly liquid assets, ensuring high liquidity levels for the pension fund. This implies that the level of assets to cover 100% of the upcoming 5y of pension payments are fully granted (assuming a risk-free rate of return). Relevant to point out that the Present Value of liabilities was calculated taking into account the target levels of pension benefits which we know beforehand that given the current funding deficit of the pension, won't be a reality any time soon. As so, by following this approach we are actually guarantying over 100% of 5y-liabilities.

ii. Fully invest Basket of Assets B in Portfolio B – we propose medium-term liabilities to be fully invested in low-risk securities such as investment-grade bonds. This way we are able to generate an expected higher income, keeping volatility of the Collective Asset Account low. The slightly higher volatility, when compared to Portfolio A, should not pose a threat to the pension fund performance since the liabilities covered here are due within 5y-15y

iii. Fully invest Basket of Assets C in Portfolio C – For the remaining assets that are expected to account for long-term liabilities, we can increase the risk exposure since their maturity horizon is still pretty far away and fluctuations on current accounts won't bear significant consequences for the time when such liabilities mature since members will always have the Solidarity Reserve to account for eventual asymmetric exposures to the market. (i.e., a member that was more exposed, timing wise, to severe economic conditions, will have in the reserve a re-balancing mechanism).

In order to test the pension fund performance, we applied 2 approaches for returns estimation: reverse-order historical simulation and a simple stochastic model (Blagiano 2009).

Starting by the first approach, given the assumption held by the case-handout of expected low-yields for the upcoming 10y, we fetched historical data for the past 20y and applied them in reverse order to our model (Damodaran 2021). The idea behind reverse-order application is to mimic the low-yield environment of the past 10y, which the MIPC takes as assumption for the upcoming 10y.

The second model followed is the one used in *Pension Funds, Life-Cycle Asset Allocation and Performance Evaluation*, (Blagiano et all 2009), where, similarly to our model, one risk-free asset and two risky assets, bonds and stocks, are modeled. To do so, a simple stochastic model is followed where the return of each risky asset is set as function of the risk-free asset, market risk premium and two disturbances factors, normally distributed with positive correlation. Algebraically the model is defined as:

$$R_t^s = R_t^f + \mu^s + \varepsilon_t^s \quad (35)$$

$$R_t^b = R_t^f + \mu^b + \varepsilon_t^b \quad (36)$$

where, R_t^s and R_t^b stand for, respectively, stock and bond returns for period t, μ^s and μ^s stand for the expected risk-premia for stocks and bonds and ε_t^s and ε_t^b stand for stocks and bonds disturbances for period t. We will depart from the same assumptions as Blagiano et all (2009), where:

D.1. $\mu^s = 0.04$

D.2. $\mu^b = 0.02$

D.3. $\sigma_s = 0.157$

D.4. $\sigma_s = 0.08$

D.5. $\rho_{s,b} = 0.2$

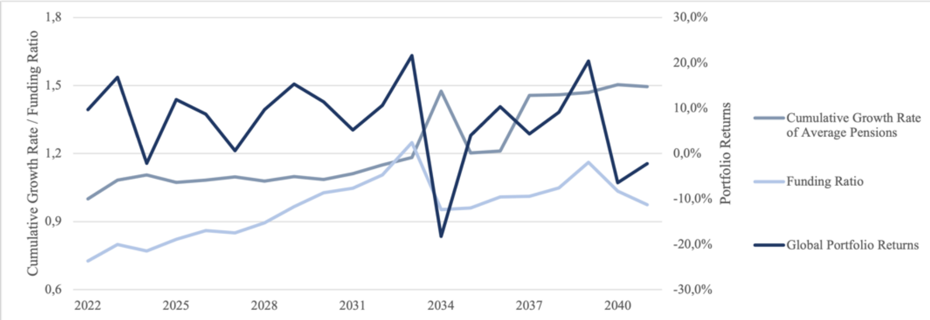
where in turn, σ_s and σ_b stand for the standard deviation of stocks and bonds disturbances, respectively and ρ_s stands for the correlation between stocks and bonds disturbances. With this approach we are able to conduct Monte Carlo Simulations on our model which in turn will help us analyze our final results and the potential fragilities to *Bouwen & Pensioen*.

7. RESULTS

For the analyses of results, since the analysis of each variable alone is already highly computational expensive, we had no choice than isolating each study variable and take the values for the remaining ones as the values set in the assumptions mentioned earlier. A better way for the present analysis would be by conducting collective Monte Carlo Simulations to the performance of the pension fund based on at least four key variables: returns contribution rate for the reserve (range 0% to 20% with increments of 1%), number of years to consider short term liabilities (0 to 10, increments of 1 year). the number of years to consider medium term liabilities (5 to 20, increments of 1 year) (long-term liabilities are self-defined) and portfolio returns (random disturbances simulated 100 times per iteration). However, since each iteration takes about one and half minutes, running the entire process would take roughly 310 days in the common computer.

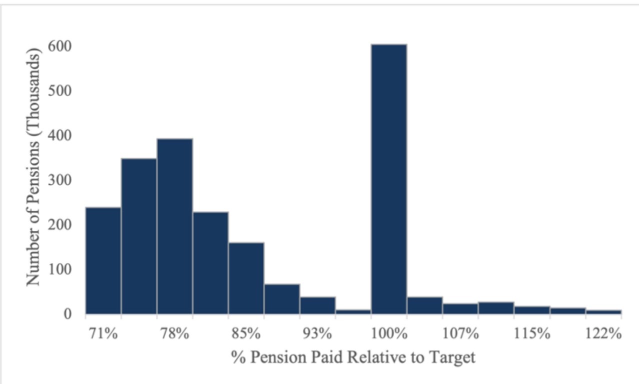
The application of the first returns model (reverse historical simulation) resulted in an average pension paid of 85.33%, and standard deviation of 12.95%. Important to remember that the 85.33% average pensions paid are relative to the target pension level which grows along the time, as demonstrated in section 5. Also important to highlight that, although we do not recommend promising pensioners pensions indexed to inflation, we do grow our target values for pensions paid accordingly to inflation. On top of this, we are also setting as goal to achieve a 100% funding ratio for the pension fund by 2041 and thus, an 85.33% average pension paid, relative to target values, with moderatily-low volatility is a result a lot more robust than what we would expect. Figure 6 presents further evidence on the robustness of the model: we are able to visualize that the high volatility (from higher exposure to risky assets) of global portfolio returns is mitigated for pension payments, i.e., despite the turbulence of financial market returns, benefits paid to pensioners are relatively stable throughout the period in study. The only negative spike occurs in the year 2034 which, since we are considering a reverse-historical-simulation, represents the financial crash of 2008. Also important to highlight the fact that outflows from the reserve are paid taking into account the relationship between the target and actual funding ratios of the previous years, thus the 1-year lag between the funding ratio and pensions growth rate.

Figure 6 - Cumulative growth rate of pensions and global portfolio returns



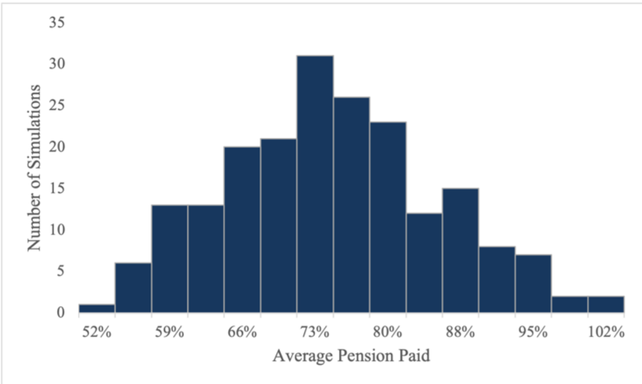
A key parameter to analyze is the equity between generations. Figure 7 exhibits the distribution of pension payments along the 20 years of forecast. From it, we can visualize that the distribution of pension payments follows a left skewed distribution with an outlier high concentration of pension payments around 100%. The reasoning behind the form of this distribution relies on the fact that the solidarity reserve will only buffer pensions below 100% and the lower the net benefit of an individual, the higher the reserve flow to her/him. For example, a pensioner with net benefit of 70% will receive a much larger reserve flow than an individual with net benefit of 90% since the model used to optimize the yearly reserve outflow distribution (SSE) penalizes more heavily the observations further from their target value. Since the individual with net benefit of 70% receives a larger compensation from the reserve account, the distribution of pensions paid becomes more concentrated around its mean values. In other words, the distribution mechanism of the reserve allows for a more equitable level of pension paid. Any value of net benefit equal or above 100% will not benefit from reserve outflows.

Figure 7 – Reversed historical simulation - Distribution of pensions



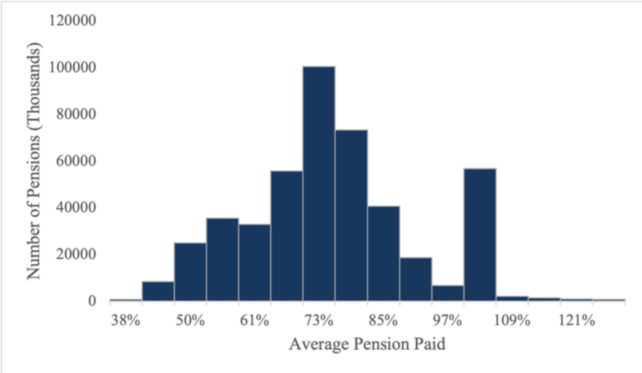
We then used the second returns model (simple stochastic model) to apply Monte Carlo Simulations to test the robustness of the proposed forecasting model. The first and immediate result, as one would expect, is that the shape of the average pension paid resemble the shape of the normal distribution. This result was already expected since we are modeling returns based on stochastic disturbances, also assumed to be normally distributed.

Figure 8 - Monte Carlo Simulations under the simple stochastic model – Average Pension



The second immediately identifiable result is the fact that under this simple stochastic returns model, the average pension paid is much lower from what we had in the first model, where we followed a reversed historical simulation approach. The reason behind the sharp difference in performances for both models relies on the fact that with the reversed historical simulation approach, the average return on corporate bonds for the past 20 years was of 7.63% and 10.96% for stocks. On the other hand, for the simple stochastic model, we assume, as commonly done in the literature, an average return on bonds of 4% and 6% for stocks.

Figure 9 - Monte Carlo Simulations under the simple stochastic model – Distribution of pensions



With the already conducted Monte Carlo Simulations, we can also output the distribution of pensions as we did for the reversed historical simulation approach. The results are relatively similar to the ones derived with the previous returns model: a shape that resembles the normal distribution until a pension level of 100% and then a significant concertation of pensions at the 100% level. Such characteristics, as previously mentioned, can be linked to a robust level of equity and fairness between members and generations, made possible by the solidarity reserve mechanism presented.

8. CONCLUSION

First and foremost, important to highlight that the model constructed is highly extensive and could be proven a lot more fruitful with higher computational power, which would allow for a multi-variable sensitivity analysis.

During the present paper, three key points were proposed:

I. To set as target the achievement of a funding ratio of 100% by 2041 in order to immunize the pension fund against future, unforeseen, structural changes.

II. A solidarity reserve mechanism that only distributes proceeds, at a macro level, for years in which the actual funding ratio of the pension fund is above its target level. This mechanism will distribute the reserve outflows, at a micro level, at any given year across all pensioners based on an SSE optimization problem, minimizing the squared differences between pensioners target and actual pensions leading to an equitable and fairer distribution of pensions.

III. To follow a liability-matching investment strategy, where short-term liabilities are invested in highly liquid, low risky assets, medium-term liabilities invested in a mix of liquid and return-seeking assets and the remaining assets (regarding long-term liabilities) invested in high-yield assets. Such strategy allows *Bouwen & Pensioen* to increase its risk exposure, and thus its solvency position, without compromising the stability of its pension commitments in the short-term.

The above presented solutions will allow *Bouwen & Pensioen* to reach in the medium-long term a funding ratio of 100% and until then, to offer its members a pension benched by hers/his individual asset account (central feature of a defined contribution scheme) buffered with proceeds from the collective reserve, when the required conditions are met (collective feature of the scheme). Also important to highlight that a longer time frame for the goal of 100% funding ratio could be set, which intuitively would increase pensions paid in the short-run. However, we do not advice *Bouwen & Pensioen* to follow such approach since it would be exposed to unforeseen structural changes of the pension fund which could change the entire optimality setting.

REFERENCES

- Blake, D. (2006). Pension Finance. John Wiley & Sons (Ed.). *Chapter 3 – Corporate Pension Finance* (pp. 77-96). Chichester, England.
- Pensions Europe (2020). Pension Funds Statistics and Trends. Available from: https://www.pensionseurope.eu/system/files/PensionsEurope%20Pension%20Funds%20Statistics%20and%20Trends%20-%20March%202020.pdf [Accessed 10/02/2022].
- Pereira, A., Wang, J. (2021) Pension Fund Challenges ahead of inflationary environment. *Lisbon Investment Society / Vitalis*. Available from: https://shorturl.at/bjkwC [Accessed: 10/08/2022].
- Poterba, James M. (2014): Retirement Security in an Aging Population. *American Economic Review*. 104, no. 5 , 1–5.
- Schuttenhelm, R. (2019). In face of rising sea levels the Netherlands 'must consider controlled withdrawal'. *Vrij Nederland*. Available from: https://www.vn.nl/rising-sea-levels-netherlands/ [Accessed: 19/08/2022].
- Westerhout, Ed, Pension Reform in the Netherlands (2020). CentER Discussion Paper No. 2020-012.
- Pensioen Federatie (2019). The Dutch pension system: highlights and characteristics. Available from: https://www.pensioenfederatie.nl/website/the-dutch-pension-system-highlights-and-characteristics [Accessed: 01/07/2022].
- United Nations – Department of Economic and Social Affairs (2022). World Population Prospects. Available from: Available from: https://data.worldbank.org/indicator/SP.DYN.LE00.IN?locations=NL [Acessed 15/09/2022]
- WorldBank (2022). Life Expectancy at Birth. Available from: https://www.pensioenfederatie.nl/website/the-dutch-pension-system-highlights-and-characteristics [Accessed: 01/07/2022].
- European Central Bank (n.d.). Monetary Policy. Available from: https://www.ecb.europa.eu/ecb/tasks/monpol/html/index.en.html

- European Federation of Building and Woodworkers (n.d.). Construction Workers: Wages and Working Conditions. Available from: https://www.constructionworkers.eu/en/nl/check-wages-and-working-conditions/the-netherlands [Accessed 10/09/2022]
- WorldBank (2022). Inflation, consumer prices (annual %). Available from: https://data.worldbank.org/indicator/FP.CPI.TOTL.ZG?locations=NL [Accessed 15/09/2022]
- PME Pensioen (n.d.). Premie, overige kerncijfers en rekenvoorbeelden. Available from: https://www.pmepensioen.nl/rekencijfers [Accessed 14/07/2022]
- Centraal Bureau voor de Statistiek (2022). Population; sex, age, generation and migration background. Available from: https://opendata.cbs.nl/ [Accessed 12/08/2022]

APPENDICES

Table 6 - Individual Schedule for person from generation 20

Generation 20 (20y in 2021)								
Age	Year	Salary	Contributions	Benefits	Return %	Absolute Returns	IAC	AOW
0	2001		€ -	€ -		€ -	€ -	€ -
1	2002		€ -	€ -		€ -	€ -	€ -
2	2003		€ -	€ -		€ -	€ -	€ -
3	2004		€ -	€ -		€ -	€ -	€ -
4	2005		€ -	€ -		€ -	€ -	€ -
5	2006		€ -	€ -		€ -	€ -	€ -
6	2007		€ -	€ -		€ -	€ -	€ -
7	2008		€ -	€ -		€ -	€ -	€ -
8	2009		€ -	€ -		€ -	€ -	€ -
9	2010		€ -	€ -		€ -	€ -	€ -
10	2011		€ -	€ -		€ -	€ -	€ -
11	2012		€ -	€ -		€ -	€ -	€ -
12	2013		€ -	€ -		€ -	€ -	€ -
13	2014		€ -	€ -		€ -	€ -	€ -
14	2015		€ -	€ -		€ -	€ -	€ -
15	2016		€ -	€ -		€ -	€ -	€ -
16	2017		€ -	€ -		€ -	€ -	€ -
17	2018		€ -	€ -		€ -	€ -	€ -
18	2019		€ -	€ -		€ -	€ -	€ -
19	2020		€ -	€ -		€ -	€ -	€ -
20	2021	€ 33 000,00	€ 4 556,16	€ -	3,2180%	€ -	€ 4 556,16	€ 14 554,00
21	2022	€ 34 047,99	€ 4 743,12	€ -	3,2180%	€ 146,62	€ 9 445,90	€ 14 845,08
22	2023	€ 34 899,19	€ 4 880,03	€ -	3,2180%	€ 303,96	€ 14 629,89	€ 15 141,98
23	2024	€ 35 771,67	€ 5 020,73	€ -	3,2180%	€ 470,78	€ 20 121,40	€ 15 444,82
24	2025	€ 36 665,96	€ 5 165,32	€ -	3,2180%	€ 647,50	€ 25 934,23	€ 15 753,72
25	2026	€ 37 582,61	€ 5 313,91	€ -	3,2180%	€ 834,55	€ 32 082,69	€ 16 068,79
26	2027	€ 38 522,17	€ 5 466,61	€ -	3,2180%	€ 1 032,41	€ 38 581,70	€ 16 390,17
27	2028	€ 39 485,23	€ 5 623,51	€ -	3,2180%	€ 1 241,54	€ 45 446,76	€ 16 717,97
28	2029	€ 40 472,36	€ 5 784,75	€ -	3,2180%	€ 1 462,46	€ 52 693,96	€ 17 052,33
29	2030	€ 41 484,17	€ 5 950,43	€ -	3,2180%	€ 1 695,67	€ 60 340,05	€ 17 393,38
30	2031	€ 42 521,27	€ 6 120,67	€ -	3,2180%	€ 1 941,72	€ 68 402,44	€ 17 741,24
31	2032	€ 43 584,30	€ 6 295,59	€ -	3,2180%	€ 2 201,16	€ 76 899,19	€ 18 096,07
32	2033	€ 44 673,91	€ 6 475,33	€ -	3,2180%	€ 2 474,58	€ 85 849,10	€ 18 457,99
33	2034	€ 45 790,76	€ 6 660,01	€ -	3,2180%	€ 2 762,59	€ 95 271,70	€ 18 827,15
34	2035	€ 46 935,53	€ 6 849,76	€ -	3,2180%	€ 3 065,80	€ 105 187,26	€ 19 203,69
35	2036	€ 48 108,92	€ 7 044,72	€ -	3,2180%	€ 3 384,88	€ 115 616,87	€ 19 587,77
36	2037	€ 49 311,64	€ 7 245,03	€ -	3,2180%	€ 3 720,50	€ 126 582,40	€ 19 979,52
37	2038	€ 50 544,43	€ 7 450,83	€ -	3,2180%	€ 4 073,37	€ 138 106,60	€ 20 379,11
38	2039	€ 51 808,04	€ 7 662,27	€ -	3,2180%	€ 4 444,21	€ 150 213,08	€ 20 786,70
39	2040	€ 53 103,24	€ 7 879,50	€ -	3,2180%	€ 4 833,79	€ 162 926,37	€ 21 202,43
40	2041	€ 54 430,82	€ 8 102,67	€ -	3,2180%	€ 5 242,90	€ 176 271,94	€ 21 626,48
41	2042	€ 55 791,59	€ 8 331,95	€ -	3,2180%	€ 5 672,35	€ 190 276,24	€ 22 059,01
42	2043	€ 57 186,38	€ 8 567,49	€ -	3,2180%	€ 6 123,01	€ 204 966,74	€ 22 500,19
43	2044	€ 58 616,04	€ 8 809,46	€ -	3,2180%	€ 6 595,74	€ 220 371,94	€ 22 950,19
44	2045	€ 60 081,44	€ 9 058,04	€ -	3,2180%	€ 7 091,47	€ 236 521,46	€ 23 409,20
45	2046	€ 61 583,48	€ 9 313,41	€ -	3,2180%	€ 7 611,16	€ 253 446,02	€ 23 877,38
46	2047	€ 63 123,07	€ 9 575,73	€ -	3,2180%	€ 8 155,78	€ 271 177,53	€ 24 354,93
47	2048	€ 64 701,14	€ 9 845,20	€ -	3,2180%	€ 8 726,37	€ 289 749,10	€ 24 842,03
48	2049	€ 66 318,67	€ 10 122,01	€ -	3,2180%	€ 9 324,00	€ 309 195,11	€ 25 338,87
49	2050	€ 67 976,64	€ 10 406,36	€ -	3,2180%	€ 9 949,76	€ 329 551,23	€ 25 845,64
50	2051	€ 69 676,05	€ 10 698,43	€ -	3,2180%	€ 10 604,81	€ 350 854,48	€ 26 362,56
51	2052	€ 71 417,95	€ 10 998,45	€ -	3,2180%	€ 11 290,34	€ 373 143,27	€ 26 889,81
52	2053	€ 73 203,40	€ 11 306,62	€ -	3,2180%	€ 12 007,58	€ 396 457,48	€ 27 427,60
53	2054	€ 75 033,49	€ 11 623,16	€ -	3,2180%	€ 12 757,83	€ 420 838,46	€ 27 976,16
54	2055	€ 76 909,33	€ 11 948,29	€ -	3,2180%	€ 13 542,40	€ 446 329,15	€ 28 535,68
55	2056	€ 78 832,06	€ 12 282,24	€ -	3,2180%	€ 14 362,67	€ 472 974,06	€ 29 106,39
56	2057	€ 80 802,86	€ 12 625,24	€ -	3,2180%	€ 15 220,10	€ 500 819,40	€ 29 688,52
57	2058	€ 82 822,93	€ 12 977,54	€ -	3,2180%	€ 16 116,15	€ 529 913,09	€ 30 282,29
58	2059	€ 84 893,51	€ 13 339,38	€ -	3,2180%	€ 17 052,37	€ 560 304,83	€ 30 887,94
59	2060	€ 87 015,84	€ 13 711,01	€ -	3,2180%	€ 18 030,36	€ 592 046,20	€ 31 505,70
60	2061	€ 89 191,24	€ 14 092,69	€ -	3,2180%	€ 19 051,78	€ 625 190,67	€ 32 135,81
61	2062		€ -	€ 29 655,34	3,2180%	€ 20 118,36	€ 615 653,69	€ 32 778,53
62	2063		€ -	€ 30 248,45	3,2180%	€ 19 811,46	€ 605 216,70	€ 33 434,10
63	2064		€ -	€ 30 853,42	3,2180%	€ 19 475,61	€ 593 838,89	€ 34 102,78
64	2065		€ -	€ 31 470,49	3,2180%	€ 19 109,47	€ 581 477,88	€ 34 784,83
65	2066		€ -	€ 32 099,90	3,2180%	€ 18 711,70	€ 568 089,68	€ 35 480,53
66	2067		€ -	€ 32 741,89	3,2180%	€ 18 280,87	€ 553 628,66	€ 36 190,14
67	2068		€ -	€ 33 396,73	3,2180%	€ 17 815,52	€ 538 047,45	€ 36 913,94
68	2069		€ -	€ 34 064,67	3,2180%	€ 17 314,13	€ 521 296,92	€ 37 652,22
69	2070		€ -	€ 34 745,96	3,2180%	€ 16 775,10	€ 503 326,06	€ 38 405,27
70	2071		€ -	€ 35 440,88	3,2180%	€ 16 196,81	€ 484 081,99	€ 39 173,37
71	2072		€ -	€ 36 149,70	3,2180%	€ 15 577,54	€ 463 509,84	€ 39 956,84
72	2073		€ -	€ 36 872,69	3,2180%	€ 14 915,54	€ 441 552,69	€ 40 755,98
73	2074		€ -	€ 37 610,14	3,2180%	€ 14 208,97	€ 418 151,51	€ 41 571,10
74	2075		€ -	€ 38 362,35	3,2180%	€ 13 455,93	€ 393 245,10	€ 42 402,52
75	2076		€ -	€ 39 129,59	3,2180%	€ 12 654,45	€ 366 769,95	€ 43 250,57
76	2077		€ -	€ 39 912,19	3,2180%	€ 11 802,49	€ 338 660,26	€ 44 115,58
77	2078		€ -	€ 40 710,43	3,2180%	€ 10 897,94	€ 308 847,77	€ 44 997,89
78	2079		€ -	€ 41 524,64	3,2180%	€ 9 938,58	€ 277 261,72	€ 45 897,85
79	2080		€ -	€ 42 355,13	3,2180%	€ 8 922,16	€ 243 828,74	€ 46 815,81
80	2081		€ -	€ 43 202,23	3,2180%	€ 7 846,30	€ 208 472,81	€ 47 752,12
81	2082		€ -	€ 44 066,28	3,2180%	€ 6 708,56	€ 171 115,10	€ 48 707,16
82	2083		€ -	€ 44 947,60	3,2180%	€ 5 506,41	€ 131 673,90	€ 49 681,31
83	2084		€ -	€ 45 846,56	3,2180%	€ 4 237,21	€ 90 064,55	€ 50 674,93
84	2085		€ -	€ 46 763,49	3,2180%	€ 2 898,24	€ 46 199,30	€ 51 688,43
85	2086		€ -	€ 47 698,76	3,2180%	€ 1 486,67	-€ 12,78	€ 52 722,20

Table 7 - Aggregate Data for 2021

Aggregate Data 2021						
Generation	#Members	TIAC	Salary	Benefits	RRR	CPVL (Thousands)
0	3943	€ -	€ -	€ -	3,2079%	€ -
1	3838	€ -	€ -	€ -	3,2079%	€ -
2	3806	€ -	€ -	€ -	3,2079%	€ -
3	3835	€ -	€ -	€ -	3,2079%	€ -
4	3901	€ -	€ -	€ -	3,2079%	€ -
5	3935	€ -	€ -	€ -	3,2079%	€ -
6	3976	€ -	€ -	€ -	3,2079%	€ -
7	3987	€ -	€ -	€ -	3,2079%	€ -
8	4000	€ -	€ -	€ -	3,2079%	€ -
9	4096	€ -	€ -	€ -	3,2079%	€ -
10	4194	€ -	€ -	€ -	3,2079%	€ -
11	4262	€ -	€ -	€ -	3,2079%	€ -
12	4279	€ -	€ -	€ -	3,2079%	€ -
13	4253	€ -	€ -	€ -	3,2078%	€ -
14	4254	€ -	€ -	€ -	3,2078%	€ -
15	4316	€ -	€ -	€ -	3,2078%	€ -
16	4413	€ -	€ -	€ -	3,2079%	€ -
17	4558	€ -	€ -	€ -	3,2078%	€ -
18	4696	€ -	€ -	€ -	3,2078%	€ -
19	4830	€ -	€ -	€ -	3,2079%	€ -
20	4996	€ 4 556,16	€ 33 000,00	€ -	3,2180%	€ 22 762,59
21	5061	€ 9 240,11	€ 33 162,93	€ -	3,2184%	€ 46 764,21
22	5024	€ 13 990,76	€ 33 324,49	€ -	3,2192%	€ 70 289,59
23	4973	€ 18 853,34	€ 33 488,32	€ -	3,2198%	€ 93 757,67
24	4912	€ 23 844,72	€ 33 653,48	€ -	3,2200%	€ 117 125,25
25	4927	€ 29 020,47	€ 33 821,21	€ -	3,2188%	€ 142 983,83
26	5007	€ 34 368,35	€ 33 989,31	€ -	3,2166%	€ 172 082,32
27	5079	€ 39 871,85	€ 34 157,62	€ -	3,2134%	€ 202 509,13
28	5119	€ 45 451,90	€ 34 324,23	€ -	3,2106%	€ 232 668,28
29	5184	€ 51 116,55	€ 34 491,73	€ -	3,2082%	€ 264 988,18
30	5207	€ 56 872,52	€ 34 660,25	€ -	3,2060%	€ 296 135,23
31	5118	€ 62 779,66	€ 34 831,37	€ -	3,2033%	€ 321 306,32
32	5008	€ 68 839,51	€ 35 003,48	€ -	3,2000%	€ 344 748,27
33	4980	€ 74 978,60	€ 35 174,25	€ -	3,1970%	€ 373 393,45
34	4962	€ 81 255,57	€ 35 347,33	€ -	3,1938%	€ 403 190,12
35	4886	€ 87 695,75	€ 35 522,14	€ -	3,1899%	€ 428 481,44
36	4773	€ 94 261,66	€ 35 696,80	€ -	3,1857%	€ 449 910,90
37	4662	€ 100 983,73	€ 35 873,06	€ -	3,1809%	€ 470 786,14
38	4607	€ 107 808,92	€ 36 048,75	€ -	3,1762%	€ 496 675,68
39	4669	€ 114 673,50	€ 36 223,25	€ -	3,1724%	€ 535 410,59
40	4728	€ 121 541,26	€ 36 397,14	€ -	3,1704%	€ 574 647,07
41	4671	€ 128 529,04	€ 36 574,93	€ -	3,1687%	€ 600 359,14
42	4592	€ 135 633,13	€ 36 753,94	€ -	3,1672%	€ 622 827,31
43	4559	€ 142 864,54	€ 36 934,18	€ -	3,1657%	€ 651 319,42
44	4537	€ 150 213,54	€ 37 115,04	€ -	3,1642%	€ 681 518,85
45	4563	€ 157 692,53	€ 37 297,07	€ -	3,1627%	€ 719 551,02
46	4664	€ 165 301,36	€ 37 480,03	€ -	3,1611%	€ 770 965,53
47	4846	€ 172 992,19	€ 37 662,32	€ -	3,1602%	€ 838 320,15
48	5131	€ 180 790,64	€ 37 845,89	€ -	3,1597%	€ 927 636,75
49	5459	€ 188 662,82	€ 38 029,28	€ -	3,1601%	€ 1 029 910,34
50	5698	€ 196 624,68	€ 38 213,61	€ -	3,1613%	€ 1 120 367,40
51	5867	€ 204 722,89	€ 38 400,10	€ -	3,1630%	€ 1 201 109,20
52	5794	€ 213 024,82	€ 38 590,05	€ -	3,1640%	€ 1 234 265,80
53	5641	€ 221 528,51	€ 38 781,58	€ -	3,1640%	€ 1 249 642,32
54	5611	€ 230 310,59	€ 38 976,84	€ -	3,1621%	€ 1 292 272,71
55	5650	€ 239 285,78	€ 39 171,56	€ -	3,1585%	€ 1 351 964,68
56	5729	€ 248 339,47	€ 39 363,09	€ -	3,1550%	€ 1 422 736,83
57	5717	€ 257 461,90	€ 39 553,62	€ -	3,1525%	€ 1 471 909,65
58	5600	€ 266 713,44	€ 39 746,11	€ -	3,1506%	€ 1 493 595,29
59	5503	€ 275 916,56	€ 39 933,75	€ -	3,1514%	€ 1 518 368,85
60	5377	€ 282 690,56	€ 40 120,81	€ -	3,1121%	€ 1 520 027,15
61	5254	€ 275 075,63		€ 13 170,99	3,1662%	€ 1 445 247,37
62	5133	€ 262 539,41		€ 12 997,80	3,1329%	€ 1 347 614,78
63	4982	€ 253 160,22		€ 13 074,99	3,1621%	€ 1 261 244,24
64	4860	€ 244 651,10		€ 13 237,13	3,2150%	€ 1 189 004,33
65	4733	€ 239 421,70		€ 13 692,51	3,3410%	€ 1 133 182,92
66	4605	€ 232 851,07		€ 14 073,17	3,4513%	€ 1 072 279,17
67	4500	€ 224 717,51		€ 14 352,27	3,5407%	€ 1 011 228,80
68	4431	€ 211 608,28		€ 14 202,20	3,5360%	€ 937 636,31
69	4323	€ 198 654,63		€ 14 067,44	3,5381%	€ 858 783,97
70	4208	€ 186 039,61		€ 13 965,43	3,5510%	€ 782 854,66
71	4187	€ 176 374,20		€ 14 166,24	3,6358%	€ 738 478,77
72	4216	€ 166 599,35		€ 14 387,95	3,7292%	€ 702 382,88
73	4318	€ 153 451,13		€ 14 248,90	3,7391%	€ 662 601,99
74	4421	€ 142 326,40		€ 14 355,83	3,8084%	€ 629 225,02
75	3768	€ 132 041,39		€ 14 606,43	3,9144%	€ 497 531,95
76	3128	€ 120 237,20		€ 14 692,80	3,9831%	€ 376 101,95
77	3032	€ 108 940,59		€ 14 899,24	4,0831%	€ 330 307,88
78	2755	€ 95 913,12		€ 14 871,10	4,1291%	€ 264 240,64
79	2489	€ 81 093,00		€ 14 505,47	4,0961%	€ 201 840,48
80	2359	€ 65 613,49		€ 13 907,81	4,0028%	€ 154 782,23
81	2235	€ 52 575,91		€ 13 807,62	4,0350%	€ 117 507,15
82	2051	€ 39 647,57		€ 13 761,65	4,0838%	€ 81 317,16
83	1841	€ 26 689,38		€ 13 770,39	4,1490%	€ 49 135,15
84	1640	€ 13 439,92		€ 13 737,69	4,2056%	€ 22 041,48
85	1470	-€ 21,34		€ 13 749,13	4,2759%	-€ 31,37

Table 8 - Immigration Table - Historical Data from CBS (Statistics Netherlands)

Year	Immigrants | Construction Sector (Thousands)	Variation (Thousands)
2017	14,1	1,00
2018	15,9	1,80
2019	17,6	1,70
2020	18,7	1,10

Table 9 - Age Matrix (Number of members per age group across time)

Age Group \ Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	3943	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	3838	3929	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	3806	3837	3915	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	3835	3806	3836	3901	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	3901	3835	3806	3835	3887	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	3935	3901	3835	3806	3834	3873	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	3976	3935	3901	3835	3806	3833	3859	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	3987	3976	3935	3901	3835	3806	3832	3845	0	0	0	0	0	0	0	0	0	0	0	0	0
8	4000	3987	3976	3935	3901	3835	3806	3831	3831	0	0	0	0	0	0	0	0	0	0	0	0
9	4096	4000	3987	3976	3935	3901	3835	3806	3830	3817	0	0	0	0	0	0	0	0	0	0	0
10	4194	4096	4000	3987	3976	3935	3901	3835	3806	3829	3803	0	0	0	0	0	0	0	0	0	0
11	4262	4194	4096	4000	3987	3976	3935	3901	3835	3806	3828	3789	0	0	0	0	0	0	0	0	0
12	4279	4262	4194	4096	4000	3987	3976	3935	3901	3835	3806	3827	3776	0	0	0	0	0	0	0	0
13	4253	4279	4262	4194	4096	4000	3987	3976	3935	3901	3835	3806	3826	3763	0	0	0	0	0	0	0
14	4254	4253	4279	4262	4194	4096	4000	3987	3976	3935	3901	3835	3806	3825	3750	0	0	0	0	0	0
15	4316	4254	4253	4279	4262	4194	4096	4000	3987	3976	3935	3901	3835	3806	3824	3737	0	0	0	0	0
16	4413	4316	4254	4253	4279	4262	4194	4096	4000	3987	3976	3935	3901	3835	3806	3823	3724	0	0	0	0
17	4558	4413	4316	4254	4253	4279	4262	4194	4096	4000	3987	3976	3935	3901	3835	3806	3822	3711	0	0	0
18	4696	4557	4413	4316	4254	4253	4279	4262	4194	4096	4000	3987	3976	3935	3901	3835	3806	3821	3698	0	0
19	4830	4695	4556	4413	4316	4254	4253	4279	4262	4194	4096	4000	3987	3976	3935	3901	3835	3806	3820	3685	0
20	4996	4829	4694	4555	4413	4316	4254	4253	4279	4262	4194	4096	4000	3987	3976	3935	3901	3835	3806	3819	3672
21	5061	4995	4828	4693	4554	4413	4316	4254	4253	4279	4262	4194	4096	4000	3987	3976	3935	3901	3835	3806	3818
22	5024	5060	4994	4827	4692	4553	4413	4316	4254	4253	4279	4262	4194	4096	4000	3987	3976	3935	3901	3835	3806
23	4973	5022	5059	4993	4826	4691	4552	4413	4316	4254	4253	4279	4262	4194	4096	4000	3987	3976	3935	3901	3835
24	4912	4971	5020	5058	4992	4825	4690	4551	4413	4316	4254	4253	4279	4262	4194	4096	4000	3987	3976	3935	3901
25	4927	4911	4969	5018	5057	4991	4824	4689	4550	4413	4316	4254	4253	4279	4262	4194	4096	4000	3987	3976	3935
26	5007	4926	4910	4967	5016	5056	4990	4823	4688	4549	4413	4316	4254	4253	4279	4262	4194	4096	4000	3987	3976
27	5079	5005	4925	4909	4965	5014	5055	4989	4822	4687	4548	4413	4316	4254	4253	4279	4262	4194	4096	4000	3987
28	5119	5077	5003	4924	4908	4963	5012	5054	4988	4821	4686	4547	4413	4316	4254	4253	4279	4262	4194	4096	4000
29	5184	5117	5075	5001	4923	4907	4961	5010	5053	4987	4820	4685	4546	4413	4316	4254	4253	4279	4262	4194	4096
30	5207	5182	5115	5073	4999	4922	4906	4959	5008	5052	4986	4819	4684	4545	4413	4316	4254	4253	4279	4262	4194
31	5118	5205	5180	5113	5071	4997	4921	4905	4957	5006	5051	4985	4818	4683	4544	4413	4316	4254	4253	4279	4262
32	5008	5116	5203	5178	5111	5069	4995	4920	4904	4955	5004	5050	4984	4817	4682	4543	4413	4316	4254	4253	4279
33	4980	5006	5114	5201	5176	5109	5067	4993	4919	4903	4953	5002	5049	4983	4816	4681	4542	4413	4316	4254	4253
34	4962	4978	5004	5112	5199	5174	5107	5065	4991	4918	4902	4951	5000	5048	4982	4815	4680	4541	4413	4316	4254
35	4886	4959	4976	5002	5110	5197	5172	5105	5063	4989	4917	4901	4949	4998	5047	4981	4814	4679	4540	4413	4316
36	4773	4883	4956	4974	5000	5108	5195	5170	5103	5061	4987	4916	4900	4947	4996	5046	4980	4813	4678	4539	4413
37	4662	4770	4880	4953	4972	4998	5106	5193	5168	5101	5059	4985	4915	4899	4945	4994	5045	4979	4812	4677	4538
38	4607	4660	4767	4877	4950	4970	4996	5104	5191	5166	5099	5057	4983	4914	4898	4943	4992	5044	4978	4811	4676
39	4669	4604	4658	4764	4874	4947	4968	4994	5102	5189	5164	5097	5055	4981	4913	4897	4941	4990	5043	4977	4810
40	4728	4666	4601	4656	4761	4871	4944	4966	4992	5100	5187	5162	5095	5053	4979	4912	4896	4939	4988	5042	4976
41	4671	4724	4663	4598	4654	4758	4868	4941	4964	4990	5098	5185	5160	5093	5051	4977	4911	4895	4937	4986	5041
42	4592	4667	4720	4660	4595	4652	4755	4865	4938	4962	4988	5096	5183	5158	5091	5049	4975	4910	4894	4935	4984

Table 9 (Cont) - Age Matrix (Number of members per age group across time)

Age Group \ Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
43	4559	4588	4663	4716	4657	4592	4650	4752	4862	4935	4960	4986	5094	5181	5156	5089	5047	4973	4909	4893	4933
44	4537	4555	4584	4659	4712	4654	4589	4648	4749	4859	4932	4958	4984	5092	5179	5154	5087	5045	4971	4908	4892
45	4563	4533	4551	4580	4655	4708	4651	4586	4646	4746	4856	4929	4956	4982	5090	5177	5152	5085	5043	4969	4907
46	4664	4558	4529	4547	4576	4651	4704	4648	4583	4644	4743	4853	4926	4954	4980	5088	5175	5150	5083	5041	4967
47	4846	4659	4553	4525	4543	4572	4647	4700	4645	4580	4642	4740	4850	4923	4952	4978	5086	5173	5148	5081	5039
48	5131	4840	4654	4548	4521	4539	4568	4643	4696	4642	4577	4640	4737	4847	4920	4950	4976	5084	5171	5146	5079
49	5459	5124	4834	4649	4543	4517	4535	4564	4639	4692	4639	4574	4638	4734	4844	4917	4948	4974	5082	5169	5144
50	5698	5450	5117	4828	4644	4538	4513	4531	4560	4635	4688	4636	4571	4636	4731	4841	4914	4946	4972	5080	5167
51	5867	5687	5441	5110	4822	4639	4533	4509	4527	4556	4631	4684	4633	4568	4634	4728	4838	4911	4944	4970	5078
52	5794	5854	5676	5432	5103	4816	4634	4528	4505	4523	4552	4627	4680	4630	4565	4632	4725	4835	4908	4942	4968
53	5641	5780	5841	5665	5423	5096	4810	4629	4523	4501	4519	4548	4623	4676	4627	4562	4630	4722	4832	4905	4940
54	5611	5625	5766	5828	5654	5414	5089	4804	4624	4518	4497	4515	4544	4619	4672	4624	4559	4628	4719	4829	4902
55	5650	5595	5610	5752	5815	5643	5405	5082	4798	4619	4513	4493	4511	4540	4615	4668	4621	4556	4626	4716	4826
56	5729	5631	5579	5595	5738	5802	5632	5396	5075	4792	4614	4508	4489	4507	4536	4611	4664	4618	4553	4624	4713
57	5717	5708	5612	5563	5580	5724	5789	5621	5387	5068	4786	4609	4503	4485	4503	4532	4607	4660	4615	4550	4622
58	5600	5693	5687	5593	5547	5565	5710	5776	5610	5378	5061	4780	4604	4498	4481	4499	4528	4603	4656	4612	4547
59	5503	5574	5669	5666	5574	5531	5550	5696	5763	5599	5369	5054	4774	4599	4493	4477	4495	4524	4599	4652	4609
60	5377	5474	5548	5646	5645	5555	5515	5535	5682	5750	5588	5360	5047	4768	4594	4488	4473	4491	4520	4595	4648
61	5254	5346	5446	5522	5623	5624	5536	5499	5520	5668	5737	5577	5351	5040	4762	4589	4483	4469	4487	4516	4591
62	5133	5221	5316	5418	5497	5600	5603	5517	5483	5505	5654	5724	5567	5342	5033	4756	4584	4478	4465	4483	4512
63	4982	5097	5188	5286	5390	5472	5577	5582	5498	5467	5490	5640	5711	5557	5333	5026	4750	4579	4473	4461	4479
64	4860	4944	5061	5155	5256	5362	5447	5554	5561	5479	5451	5475	5626	5698	5547	5324	5020	4744	4574	4468	4457
65	4733	4818	4907	5026	5123	5226	5334	5422	5531	5540	5460	5435	5460	5612	5685	5537	5315	5014	4738	4569	4463
66	4605	4688	4776	4870	4991	5091	5196	5306	5397	5508	5520	5442	5419	5445	5598	5672	5527	5306	5008	4732	4564
67	4500	4559	4643	4735	4833	4956	5059	5166	5278	5372	5485	5500	5424	5403	5430	5584	5659	5517	5297	5002	4726
68	4431	4450	4513	4599	4694	4796	4921	5027	5137	5251	5347	5462	5480	5406	5387	5415	5570	5646	5507	5288	4996
69	4323	4376	4401	4468	4555	4653	4760	4887	4995	5108	5224	5322	5439	5460	5388	5372	5400	5556	5633	5497	5279
70	4208	4264	4322	4353	4423	4512	4613	4724	4853	4964	5079	5197	5297	5417	5440	5370	5357	5385	5542	5620	5487
71	4187	4145	4206	4268	4305	4378	4469	4573	4688	4819	4933	5050	5170	5273	5395	5420	5352	5342	5370	5528	5607
72	4216	4119	4083	4149	4215	4258	4334	4427	4533	4653	4785	4902	5021	5143	5249	5373	5400	5334	5327	5355	5514
73	4318	4139	4053	4021	4093	4163	4211	4290	4385	4494	4618	4752	4871	4992	5116	5225	5351	5380	5316	5312	5340
74	4421	4228	4064	3988	3960	4037	4111	4165	4247	4343	4455	4583	4719	4840	4964	5089	5201	5329	5360	5298	5297
75	3768	4316	4140	3990	3924	3900	3982	4060	4119	4204	4302	4416	4548	4686	4810	4936	5063	5177	5307	5340	5280
76	3128	3661	4213	4054	3917	3861	3841	3928	4010	4074	4162	4261	4378	4514	4653	4780	4908	5037	5153	5285	5320
77	3032	3030	3557	4113	3970	3846	3799	3783	3875	3960	4029	4120	4221	4340	4480	4620	4750	4880	5011	5129	5263
78	2755	2928	2935	3456	4015	3887	3776	3738	3726	3822	3911	3985	4078	4181	4302	4446	4588	4720	4852	4985	5105
79	2489	2649	2827	2843	3357	3919	3806	3707	3678	3670	3770	3862	3941	4037	4141	4265	4412	4556	4690	4824	4959
80	2359	2381	2547	2730	2754	3261	3826	3727	3640	3619	3615	3719	3814	3898	3996	4102	4228	4379	4524	4661	4797
81	2235	2245	2278	2449	2636	2668	3168	3735	3650	3574	3561	3561	3668	3767	3855	3956	4063	4191	4346	4492	4632
82	2051	2116	2136	2179	2355	2545	2585	3078	3646	3574	3509	3504	3507	3618	3720	3813	3916	4024	4155	4313	4461
83	1841	1926	2003	2033	2084	2264	2457	2504	2990	3559	3500	3445	3447	3454	3569	3674	3771	3877	3986	4119	4280
84	1640	1712	1809	1896	1935	1993	2177	2372	2426	2905	3474	3427	3382	3391	3402	3520	3628	3729	3838	3948	4083
85	1470	1503	1592	1699	1795	1841	1906	2093	2290	2350	2822	3391	3356	3320	3336	3351	3472	3583	3688	3799	3910

Figure 10 - Net flow of Members with / without Immigration

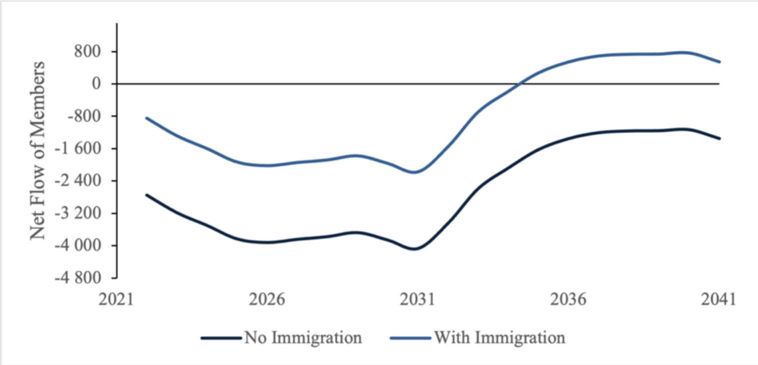
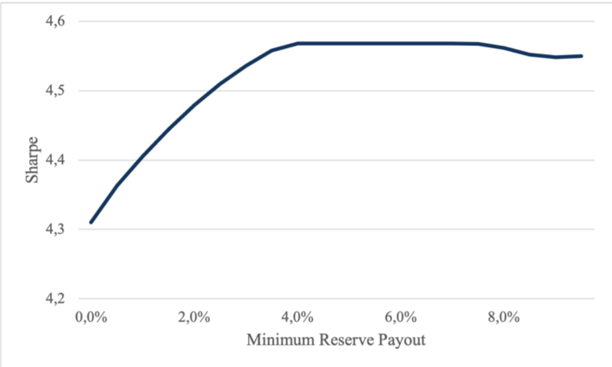


Figure 11 - Optimal Minimum Reserve Payout



THE END