

THE IMPACT OF RECTIFICATION ON THE GUARANTEED MINIMUM PENSION IN THE UNITED KINGDOM

João Gonçalo Ferreira Martins

Project Work presented as a partial requirement for
obtaining the Master's degree in Statistics and
Information Management

NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação
Universidade Nova de Lisboa

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Advisor: Prof. Dr. Carlos Manuel Pereira da Silva

Co-Advisor: Prof. Dr. Jorge Miguel Ventura Bravo

November 2022

ACKNOWLEDGEMENTS

I would like to thank Professor Carlos Silva, advisor of this project work, for all the monitoring and availability as well as all the good suggestions provided.

To Rui Martins, co-worker and supervisor, I am very grateful for the opportunity he gave me to do this project and for always being available to help with my questions.

To my family, especially my parents and my sister who believed in me from the beginning and never doubted that I would get this far. Thank you so much for all the personal and professional principles that you have passed on to me throughout my life.

To my lovely girlfriend, Marta Barceló, thank you from the bottom of my heart for always supporting me in every moment. Also for pushing me up every day and never doubting my potential.

ABSTRACT

Over the years, people feel more and more concerned about saving and, therefore, choose to set up a **pension** fund with the aim of guaranteeing an income after retirement age. For this, they have to give up part of their earnings and, depending on various factors, the pension can take different dimensions.

In the **United Kingdom** (UK), this process differs from other countries. Between 1978 and 1997, people could choose whether to contribute their taxes in full to the government or to transfer part of that contribution to a **private pension fund** provided by the company where they worked, always complying with the rules imposed by the state. This part of the pension was called the **Guaranteed Minimum Pension** (GMP) and the remainder was Excess (XS).

However, in 2018, a claim by some female members, due to gender inequalities felt in the pension calculation, led Her Majesty's Revenue and Customs (HMRC) to impose on all pension funds readjust pensions to eliminate these differences. Nevertheless, the state did not indicate how companies should apply the necessary changes, leaving them only to present the method used. All of this will be decided and applied in the designated GMP treatment process.

In this project, the second of four phases of this process will be studied: the **Rectification** of the Guaranteed Minimum Pension. This is based on the recalculation of values and updating of the information used in each person's pension. For this, recalculation methods already used will be evaluated in Excel and the results will be measured using **the Pension Wealth** concept to see not only the current adjustments but also future pension growth.

KEYWORDS

Pension, United Kingdom, Guaranteed Minimum Pension, Private Funds, GMP Rectification, Pension Wealth

RESUMO

Com o passar dos anos, as pessoas se preocupam cada vez mais em poupar e, por isso, optam por constituir um fundo de pensão com o objetivo de garantir uma renda após a idade da aposentadoria. Para isso, têm que abrir mão de parte de seus ganhos e, dependendo de vários fatores, a pensão pode assumir diferentes dimensões.

No **Reino Unido** (UK), esse processo difere dos outros países. Entre 1978 e 1997, as pessoas podiam escolher entre contribuir com seus impostos integralmente para o governo ou transferir parte dessa contribuição para um **fundo de pensão privado** fornecido pela empresa para a qual trabalhavam, cumprindo sempre as regras impostas pelo estado. A esta parte da pensão foi chamada a **Pensão Mínima Garantida** (PMG) e ao remanescente de Excesso (XS).

No entanto, em 2018, uma reclamação por parte de alguns membros do sexo feminino, por motivos de desigualdade de gênero sentidos no cálculo da pensão, levou a Her Majesty's Revenue and Customs (HMRC) a impor a todos os fundos de pensões que reajustassem as suas pensões de forma a eliminar estas diferenças. No entanto, o estado não indicou de forma clara como é que as empresas deviam aplicar as alterações necessárias, ficando estas apenas de apresentar qual seria o método utilizado. Tudo isto será decidido e aplicado no processo designado de tratamento da PMG.

Neste projeto, será estudada a segunda de quatro fases deste processo: a **Retificação** da Pensão Mínima Garantida. Esta baseia-se no recálculo dos valores e atualização das informações utilizadas na pensão de cada pessoa, de forma a garantir que as pensões estão prontas a serem equalizadas. Para isso, os métodos de recálculo já usados serão avaliados no Excel e os resultados serão medidos usando o conceito de **Riqueza de Pensão** para ver não só os ajustes atuais, mas também o crescimento futuro da pensão.

PALAVRAS-CHAVE

Pensão, Reino Unido, Pensão Mínima Garantida, Fundos Privados, Retificação da PMG, Riqueza de Pensão.

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ACRONYMS

BSP	Basic State Pension
CARE	Career Average Revalued Earnings
CPI	Consumer Price Index
DB	Defined Benefit
DC	Defined Contribution
DOL	Date of Leaving
DOR	Date of Retirement
GMP	Guaranteed Minimum Pension
GMPA/GPA	Guaranteed Minimum Pension Age
GMPD/GPD	Guaranteed Minimum Pension Date
HMRC	Her Majesty's Revenue and Customs
LPI	Limited Price Index
NIC	National Insurance Contributions
NRA	Normal Retirement Age
PSPS	Public Service Pension Schemes
RPI	Retail Price Index
S2P	State Second Pension
SERPS	State Earnings Related Pension Schemes
SPA	State Pension Age
SRS	Scheme Reconciliation Service
UK	United Kingdom
XS	Excess

1. INTRODUCTION

1.1. FRAMEWORK AND PROBLEM IDENTIFICATION

A **pension** plan works like a retirement plan, requires contributions from a person (member) or company belonging to a pension fund that will be managed by administrators (trustees), to increase the amount invested that will be returned to the member after he retires. Usually, the three most common types of pension plans in the world are the state pension, provided by the state that follows the values registered by the main market indexes; the personal pension plan, where each person individually decides their plan, is usually linked to insurance companies; and also, the occupational pension scheme, provided by the companies' employers, managed by trustees, usually with higher qualifications and with a focus on maximizing the amount invested by employees. In addition, the latter fund can be divided into two distinct classes, defined benefit (DB) and defined contribution (DC) funds. In the first, members know *a priori* how much they will receive according to the amount contributed (this can vary). However, for the second, the fixed part is the contribution, and the benefit is only known on the retirement date. Depending on the type of fund, it is possible to foresee in which side is the risk, whether from the employer or the employees.

In the **United Kingdom** (UK), pension funds are somewhat more complex than in most other countries. The state pension is divided into two parts, the Basic State Pension (BSP) and the State Second Pension (S2P) or additional state pension. Between 1978 and 1997, the population of the UK could get benefit by redirecting the additional state pension to a private pension fund (occupational fund) which, not only facilitated the reduction of applied rates but also, usually involved greater future yield due to better management of scheme Trustees. Specifically for this country, this pension is divided into two elements, the **Guaranteed Minimum Pension** (GMP) and the Excess Pension (XS). The GMP reflects the pension amount provided by the state between 1978 and 1997 if the member decides to keep his additional pension contributions to the state and the remainder is called Excess Pension.

In 2018, some female members belonging to private fund schemes felt inequalities in the calculation of GMP between genders taking this situation to court (Lloyds case). The UK court concluded that most pensions would have to be recalculated, setting the date March 31, 2019, as the final reconciliation date with **Her Majesty's Revenue and Customs** (HMRC), before the equalisation changes are applied. HMRC is the government entity responsible for regulating pension funds as well as increasing UK income using taxes (What is HMRC?, n.d.). With this, several methods were established to resolve the inequalities between the members, for this project, is intended to observe the impact of correcting what was done by the scheme with what was defined by the state on the members' pensions.

1.2. RELEVANCE/IMPORTANCE OF THE THEME

The origin of pension funds derives from the state's need to sustain the country's economy, and for this, it imposed on society to lend part of their income, currently called social security, to develop the region socially and economically. However, the state had to promise future income after retirement age as a reward for the help provided.

One of the biggest challenges regarding pension funds is the increase in the retirement age being a matter of concern for people who have large amounts of money contributed to the state, for this,

private funds have emerged allowing many people to get around this situation, since, in this way, they are mitigating the risk of longevity, caused by the increase in average life expectancy, obtaining a higher and more secure income.

On the other hand, in the UK, this issue arises from the fact that administrators need to comply with what was required by HMRC, regarding the treatment of GMP for their schemes, thus seeking companies, capable of managing their funds by applying the necessary changes in their respective pensions.

The first phase of this process was called **GMP Reconciliation**, where an agreement was reached on what changes to make in pension funds, what data to use, and what methods to apply. This is followed by the **Rectification of the GMP** which, being a decisive part of the process, since it concerns the pensions of millions of people, with over \$35 trillion invested, that will probably be the last and only income that these people will have in last years of their lives. Putting into practice what was decided in the reconciliation, the first phase must record all and only the necessary information to be able to apply the process with a recommended degree of confidence.

Believing that all these changes do not come to directly benefit or harm anyone, these measures came to make this type of income more homogeneous among different genders, fair among the parties involved, and legal for the decision of the state.

With this, it is concluded that changes in laws or the imposition of new rules should not be seen as problems, but as challenges that will be overcome by new methods adjusted to them.

1.3. STUDY OBJECTIVE

The process of treating GMP follows a path consisting of four phases and, for this project, the objective is to represent practically, with the supervision and support of a Pension Fund Management Company, the second phase: Rectification of the Guaranteed Minimum Pension. This phase involves the recalculation and comparison of the pension using newly updated data. Subsequently, the results of the Rectification will be used to measure the impact on different population groups through the Pension Wealth concept, which, more than the current value of the pension, measures their growth over the years.

It will be studied only UK pension funds, with Defined Benefit pensions, and people with service between 6 April 1978 and 5 April 1997, also known as the GMP period. This element of the pension is treated quite differently from the others and it is intended to assess what are the differences after the treatment and recalculation of the pension.

With this work, it is expected to learn how to perform the process itself and, later, describe the method, identifying results, advantages, presenting possible improvements and making comparisons with previously used methods. Furthermore, understand which groups of people were more positively and negatively affected by this correction in pensions.

In addition, since it is a project within a business context, one of the objectives will be to add value to the company, whether by learning how to perform the process well or even in the construction of training material, both for the youngest and for those who already apply it.

This project is divided into four chapters. The first is an introduction to the topic, which includes a framework in the UK pension system, the importance of pensions in people's lives as the last source of income and the objective of this study as a business project. The second chapter, is the Literature Review and addresses several concepts from the composition of different types of pension funds, the pension correction process and the type of analysis used on the results, the Pension Wealth.

The third chapter covers the Methodologies, presenting the elements to be taken into account in the recalculation and rectification process, the data used and the step-by-step of GMP Rectification. The last chapter goes through an analysis of the results of the GMP Rectification process and the Pension Wealth variation of the categorically divided population.

2. LITERATURE REVIEW

The UK Pension system is made up of three different contribution groups, the State Pension, the Public Service Pension Schemes and the Private Pension Schemes (Europa EU, 2014). In practice, these pensions serve as a replacement for people's income when they retire and reach the Normal Retirement Age (NRA) until they die and later, will be transferred to a Spouse or the legal Dependents with a certain associated percentage.

2.1. TYPES OF PENSION SYSTEMS

2.1.1. State Pension Schemes

As the name implies, the **State Pension** is related to contributions made to the state, in the UK is named as HMRC. This system is divided into two parts, the Basic State Pension and the Additional State Pension, the second previously known as State Earnings Related Pension Schemes (SERPS) (Gov UK). Both are funded by earnings-related National Insurance Contributions (NIC). Participation in this system is mandatory for everyone. In the schemes that will be studied, being older, it will be assumed that the state pension age, the age at which they can claim their state pension, is 65 years for men and 60 for women. However, it is known that these values are constantly changing because of the pandemic, technology development but now they are currently both around 66 years old (Gov UK).

In 2014, to be entitled to a full basic state pension required at least 30 years of NICs, i.e. for each year of NICs, people are entitled to 1/30th of this full basic state pension. It is not possible to claim it before the State Pension Age (SPA), but if someone intends to continue in business after this age, will benefit from a percentage increase in the amount receivable. However, in 2016 a new state pension was created to simplify the old system for people who reached their SPA after 6 April 2016.

2.1.2. Public Service Pension Schemes

Public Service Pension Schemes (PSPS) are aimed at public sector employees and may be grouped with the State Pension. These can vary between different schemes as some are based on final earnings and others on average revalued earnings. They use different accrual rates, employee and employer contribution rates, revaluation rates, Normal Retirement Ages, lump sum commutation rates and indexation rates.

2.1.3. Private Pension Schemes

Private Pension schemes can be divided into Defined Benefit (DB) and Defined Contribution (DC) schemes.

Defined Benefit schemes are based on years of service and final salary, or career average revalued earnings (CARE) and on which members are promised a benefit when they retire. In these types of schemes, the employer bears the risk of additional funds to ensure that the benefit is paid to members.

In **Defined Contribution** schemes pensions vary depending on people's contributions and the investment returns they generate, so employees bear the risk as they are not guaranteed that their pension will grow. They are also known as Money Purchase schemes, as members contribute to a pot of money to exchange for income at retirement age (Even & Macpherson, 2007).

Since these two large types of private pension are included in occupational schemes, they are in most cases contracted out of State Earnings Related Pension Schemes (SERPS), but the government only allows contracting out if the pension meets some conditions, such as the benefit is not less than what they were entitled to if they were not contracted out and from this restriction the term Guaranteed Minimum Pension emerged.

2.2. GUARANTEED MINIMUM PENSION

If a member belongs to a pension fund (scheme), this will reduce their contributions and the member is said to be "contracted out" (Davies, 2021). The **Guaranteed Minimum Pension (GMP)** is the minimum pension that members have the right to receive from their contributions accrued between 6th April 1978 and 5th April 1997 if they decide to stay with its contributions in the state pension, it is beneficial to people to contracting-out from State Pension second plan to a Private Pension Scheme due to a possible extra in the pension named Excess (XS), which follows scheme-specific rules. The GMP follows different rules from the "non-GMP benefits" such as increase rates; pensions paid to dependants/spouses, revaluations up to the GMP Age and late retirement factors. The GMP has statutory increases to offset inflation rates. At the moment, the index used as a reference is the Consumer Price Index (CPI) (Techzone, 2021).

Payment of these increases is split between the state and the scheme employer, however, the GMP that goes into payment is the full responsibility of the pension fund. The latter must also guarantee that the pension is not less than the NIC's and that the member receives their SERPS.

The beginning of the payment of this important portion of the pension occurs when someone reaches a specific age and date:

GMP Age (GMPA/GPA) - which is 65 for men and 60 for women.

GMP Date (GMPD/GPD) – the date when members reach their GMPA/GPA.

2.3. GMP JOURNEY

The first step is to make the **GMP Reconciliation** between membership data and HMRC figures. This is usually completed when a member is close to reaching their GMPA, although sometimes these calculations can be anticipated to avoid problems that might happen when HMRC's Scheme Reconciliation Service (SRS) is removed.

During the reconciliation process and also in the rectification process, some issues must be considered to complete these steps successfully, consistently and in the shortest possible time (Brassett, 2020):

- **Set the correct tolerance levels** for differences between the scheme and HMRC values and decide what administrators should do when these tolerances are not met.
- **Considering the consequences** of the decisions taken, such as a more detailed and personalized investigation for a group of members, may imply a greater demand for the rectification of the pension; the impact of accepting HMRC values, sometimes large differences must be investigated to understand which side will be correct before simply changing the values.

- **Solve problems efficiently.** Related to the first two topics, a well-defined project plan should be in place so that major changes are not required after reconciliation and rectification have been made. In cases where it is decided to increase some tolerance levels or remove some people from the scope due to insufficient information, the work for those involved in these two stages can be reduced, but there is someone who will have to spend time integrating all the knowledge of the scheme and solving these particular cases.

GMP Rectification involves calculation and correcting data, or benefits in payment in the case of Pensioners, for the members that in GMP Reconciliation was decided to make a change in GMP held by scheme administrator, where through the manipulation of data and what was agreed in the first phase, the pension of the members is rectified (GMP EQUALISATION WORKING GROUP, 2020).

When the changes made are accepted, the pensions are submitted to the **GMP Equalisation**, which aims to balance the differences felt between genders, whether within the same scheme or in different schemes, which most of the time means uplifting some members' benefits (GMP equalisation, n.d.).

Finally, there is the **GMP Conversion** which the goal is to transform the GMP into scheme standard benefits so that it becomes easier to manage employee benefits. It aims to reduce the cost of data administration and actuarial calculations (Pires, 2021).

2.4. PENSION WEALTH

A member's Pension Wealth determines the present value of their pension benefits, taking into account taxes and social contributions that people pay when retired. Features such as age at retirement, life expectancy and indexation will affect the member's Pension Wealth. Being the current amount of all the future income that a person will receive, it is an advantage to use this concept as a measure than using the change on the current pension annuity. Sometimes the current changes may not represent the big picture.

In DB schemes, Pension Wealth is calculated by finding the annual benefit that a worker would receive if he left the scheme today. The benefit will depend on the member's years of service and earnings, receiving the corresponding revaluation until he has reached retirement age and then getting his pension to increase according to scheme rules for the remainder of the worker's life.

Looking at DC schemes, it may seem more difficult to estimate this due to not knowing how the benefit will grow. It is much easier than that, Pension Wealth is equal to the value of the funds in their accounts. In each pay period, the scheme may contribute a certain amount to workers' funds. Employer's contributions may be augmented by employee's contribution. Future benefits are determined entirely by the value of the fund at retirement. Current Pension Wealth does not require the calculation of projection of future earnings or rates as in Defined Benefit funds. Although it is not affected by job changes, the worker will always bear all rate of return risks.

2.5. LIFE EXPECTANCY

Currently, it can be said that the population lives longer and healthier lives than in the last century, but that is interpreted as a "high-class problem", said Bill Clinton, former president of the United States of America. Public pension systems were established when a person was still expected not to live many more years beyond their retirement age, some did not even retire at all. However, in 2010 life

expectancy at age 65 was almost 17 years for men and 21 for women in OECD countries. The probability that a newborn will survive to age 65 is more than 80% for a boy and greater than 90% for a girl (Morgan & Rozée, 2020).

However, the aging of the population includes enormous challenges for the economy, health policies and pension systems. There are still adjustments to be made when comparing rates for today's taxpayers, contributors, retirees and future retirees.

The growth in average life expectancy, especially for the elderly, has been underestimated in past years. For the UK only, previous projections of average life expectancy turned out to be wrong, mainly in the long term due to underestimations in the improvement in mortality, sometimes even substantially.

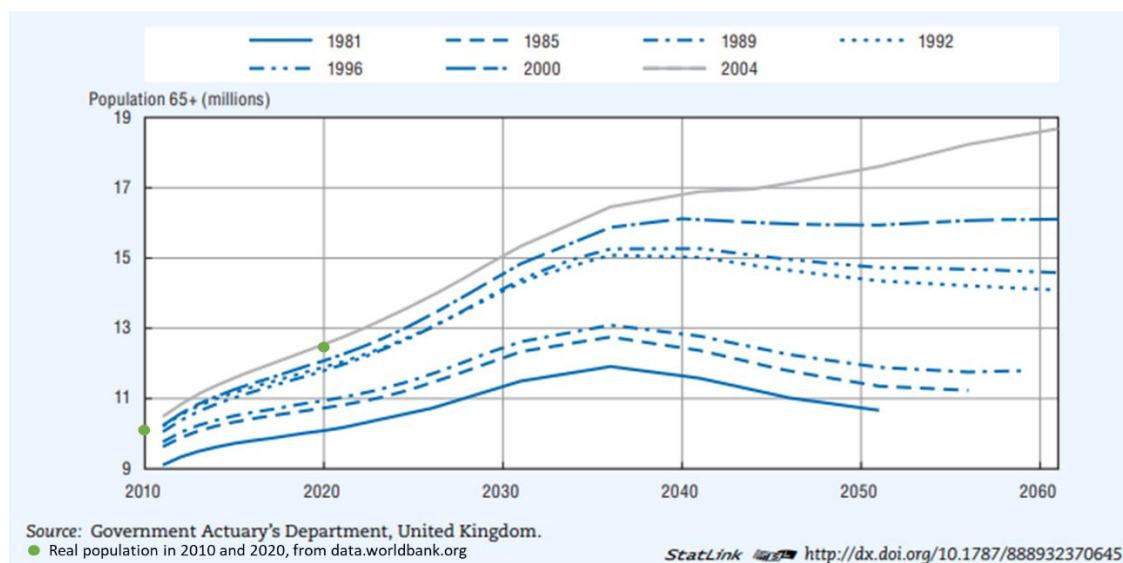


Figure 2.1 - Official projections of the population aged 65+ for the years 2011-61, United Kingdom

Figure 2.1 shows an estimate in 1981 of 9M people aged 65 and over in 2010 with a peak of 12M in 2036 followed by a decline over the years. However, in the following estimates, it is understood that the increase in average life expectancy will have been underestimated, since, in the estimate made in 2004, the initial value of the interval is almost 11M people, estimating that, not only in 2036 there will be almost 17M people, as this year will not be the peak population of this region.

In the 20th century, the world of pensions was largely dominated by defined benefit schemes, in which benefits generally depended on the number of years of contribution and a measure of individual earnings. This fact added to the increase in the average life expectancy and the high levels of inflation brought great difficulties in the sustainability and predictability of the growth of funds by employers. However, in the past years, this difficulty has been resolved as pension systems across the world have become more diverse. In Table 2.1 it is possible to observe some changes in the main countries with special attention to those that are already adjusted to their average life expectancy.

	Mandatory defined-contribution plan	Notional accounts scheme	Benefits linked to life expectancy	Qualifying conditions linked to life expectancy	DB-to-DC shift in voluntary private provision
Australia	•				
Austria					
Belgium					
Canada					•
Chile	•				
Czech Republic					
Denmark				•	
Estonia	•				
Finland			•		
France				•	
Germany			•		•
Greece					
Hungary	•				
Iceland					
Ireland					•
Israel	•				
Italy		•			
Japan					
Korea					
Luxembourg					
Mexico	•				
Netherlands					
New Zealand					
Norway	•	•			
Poland	•	•			
Portugal			•		
Slovak Republic	•				
Slovenia					
Spain					
Sweden	•	•			•
Switzerland					
Turkey					
United Kingdom					•
United States					•

Note: See country profiles in Part III for more details on national schemes.
DB = Defined benefit; DC = Defined contribution.

StatLink  <http://dx.doi.org/10.1787/888932372279>

Table 2.1 - Country solutions to link pensions to life expectancy

In defined benefit schemes, the solution to adjust pensions taking into account the unpredictability of life expectancy will be to apply long-term pension reductions (if the member lives longer than expected). On the other hand, for defined contribution schemes, the accumulated contributions and the returns on the respective investments are converted into a fixed amount, called an “annuity”. The recalculation of the annuity will be based on projected life expectancy at the time of retirement, so rates will be lower as people live longer.

2.6. BENCHMARKING

Each country's pension system may include different components, but over the years there has been a move to replace most DB plans, which are beneficial from an employee perspective, with DC or even hybrid plans, which protect the risk taken by the employer. The following are the pension plans that exist in the largest Western European economies, (Fontes, 2015).

In the **United Kingdom**, a two-state pension scheme is offered, the BSP and the S2P. The BSP is a lump sum that depends on a person's social status, £113.10/pw for a single person and £180.90 for a couple. It is paid once the normal retirement date is reached and is reduced if the member does not have at least 30 years of contributions. S2P to help lower paid individuals, from 2002 onwards, includes a fixed

amount of £92/pw plus 10% of pensionable salary. In the private sector, there is a portion of the pension, usually 25%, that can be exchanged for a tax-free lump sum at retirement date. There are very few DB plans with active members, while almost 40% offer employees a DC plan.

In **Germany**, the average salary of the entire career, the number of years of service and the revalorisation indicated are used to calculate the state pension. The retirement age can vary between 65 and 67, depending on the year of birth, and only 5 years of contributions are required. The state contribution is the same as the taxpayer's, which is a DC plan from the employer's perspective and a DB plan from the employee's perspective. In the private sector, about half of the companies still offer DB pension plans, but the trend is towards more and more hybrid plans. To calculate the pension, the last base salary before retirement or the average of the last three to five years of service is used.

In **Spain**, the method used to calculate the state pension includes the sum of 50% of the first 15 years of contribution and an increasing percentage is applied for each additional month until it reaches 100%, which corresponds to 37 years and 6 months of contribution. In companies, more than half offer pension plans, largely being DC. Typically, DB plans are only offered to senior positions within companies. There is also the possibility of opting to lump-sum a portion of the pension.

In **France**, the State supports a DB plan and there is the addition of DC plans from complementary schemes, which vary by "contribution points" that are accumulated over the years. There may also be retirement allowances, applied to the entire salary. The state pension constitutes 50% of pensionable salary, with retirement age between 65 and 67. In private plans, many provide DC plans, while the minority of DB plans typically offer 1% to 1.5% of the final salary per year of contribution, capped at 35 years.

In **Italy**, the state offers a hybrid pension system, with the normal retirement age at 67. In the private sector, only DC plans currently exist. Only a few cases of retirement before 1993 have a DB plan, essentially in banks and insurance companies.

Finally, in **Portugal**, the State offers a pension calculated by applying a percentage of remuneration for each year of service up to 20 years of contribution. Thereafter, a percentage between 2% and 2.3% is applied up to a maximum of 40 years. The normal retirement age is 66 with a minimum of 15 years of contribution. In the private sector, the new plans are mostly DC but there are still many DB plans whose monthly pension is on average 10% to 15% of the final base salary, or the average of the last three to five years.

3. METHODOLOGY

For this work, the goal is to reproduce the GMP Rectification process and use the results to analyse the impact of these changes on UK pensions, it was decided to use the Pension Wealth concept to measure the impact on members' pensions. Characteristics such as gender, age and years of service will be used to group the population under analysis. It is known that not all schemes are sufficiently numerous to carry out this type of analysis and, therefore, schemes of different dimensions will be (individually) studied to obtain homogeneous results. In addition to this, the term "years until GMPA" also emerged as a significant variable, as both genders don't reach their GMPA at the same age.

A company responsible for managing pension funds will provide the data. These are stored in a database divided into two categories, administrative and payment, the first containing information on all members registered in the scheme and the second only having data relating to members with a pension in payment. In the first instance, the data is extracted to Excel and any personal data is going to be manipulated so the members get their data protected and not exposed to everyone. After the extraction is made, a general analysis (called "Initial Analysis") is followed, where the methods to be used in the scheme are determined (object to analyse).

It is important to know how to distinguish members' categories. In the administrative category, the classification of members is as follows:

- Active (status 1) – members who are currently employed by the company and making contributions to the scheme's private fund;
- Deferred (status 2) – members who were, but are no longer contributing to the scheme, however, are entitled to a pension that undergoes revaluations until the member retires;
- Retired (status 3) – members who are already receiving the pension that comes from contributions made to the scheme;
- Dependant/Spouse (status 4) – person associated with a deceased original member, thus being entitled to a pension under the scheme, usually around 50% of the member's benefits.

There are still other statuses, but they are not identified because they are not relevant to the process.

In the Payment category, there is an easier way to split members: those who are currently receiving a pension are called **Active** members; the members that retired but didn't receive the first payment are at **Starter** status; the members that left the scheme, because they died, transferred their liabilities to other fund or get paid the annuity amount in only one payment (called commutation) will be classified as **Leaver** members. Also, for some cases, they may not be registered in the scheme because they are older than the system.

3.1. GMP CALCULATION

Although it is not directly necessary for this process, it is important to explain how to calculate the Guaranteed Minimum Pension and the different phases.

The GMP is divided into two components:

Pre 88 GMP – Accrued between 6th April 1978 and 5th April 1988

Post 88 GMP – Accrued between 6th April 1988 and 5th April 1997

The sum of both components gives the Total GMP of the member. Both are calculated as:

$$GMP = \frac{Earnings}{Contribution Rate \times Accrual Rate} \quad (3.1)$$

- Earnings – member's income during the specific period
- Contribution Rate – employee's contribution
- Accrual Rate – the rate at which interest is accrued multiplied by the working lifetime of the member. It is different between both periods, 25% for Pre 88 GMP and 20% for Post 88 GMP.

Working lifetime is the number of complete tax years between the member's start date (not older than 6th April 1978) and the last year of GMP accrual (the last 5th April before GMP Date). Subjected to a minimum of 20 and a maximum of 49 years for males and 44 for females, the maximum being the difference between 16 (minimum working age) and the GMPA.

Note that male dependants are not eligible to receive Pre 88 GMP pension from their original members, instead of that, the correspondent amount is received as Excess pension.

The GMP pension can be presented in three different instances: the **exit date** or **date of leaving**, on which the member ceases to make contributions to the scheme, normally when he leaves the company, thus leaving a pension preserved in the scheme's pension fund; the **Guaranteed Minimum Pension Age**, the date on which the member can claim their GMP pension, it is 65 years for men and 60 for women; and the **current date**, the amount to be received in the current tax year, for members who are already beyond the GMP Age. It can also be calculated at **the ceasing date** (original members' date of death) for dependant members, which works similarly to GMP Age calculation since dependants are immediately entitled to receive the GMP from the original record if the member dies before that date, or similar to current date if the member dies afterward.

Firstly, the GMP amount is calculated at the date of leaving as presented in (3.1), but using the defined revaluation rate, the value of GMP at GMP Age can be calculated. After that, if applied the correct increases until the current date, is obtained the GMP at the current date.

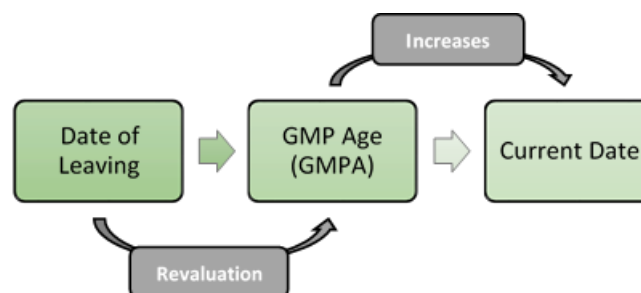


Figure 3.1 - Different instances of the GMP calculation

3.1.1. GMP Revaluation

When a member leaves the scheme before reaching their GMPA, the pension will be preserved on the scheme and the “slice” corresponding to the GMP pension will suffer revaluations until the GMP Payment Date (GMPD/GPD) while the rest of the pension will stop revaluation on the moment that the member retires, which may be different from GMP Age. This revaluation may differ between schemes and can follow one of the following methods:

- Section 148 revaluation
- Fixed-rate revaluation
- Limited rate revaluation

Section 148 revaluation

Section 148 or S148 Orders as it is usually called, increases each complete tax year (which changes every 6th of April) from the Date of Leaving (DOL) until the GMPA or Death if earlier. These are published each April showing the percentage increases based on the national average earnings increase for the year to the previous September.

The revaluation table can be found in ANNEX 1 and can be calculated by choosing the Exit Date in the vertical column on the left and the date on which it is necessary to revalue the pension is chosen in the horizontal line above.

$$GMP_{GMPA} = GMP_{DOL} \times \left(1 + \frac{s148 \text{ reval rate}}{100}\right) \quad (3.2)$$

With GMP_{DOL} being the pension calculated at the date of leaving.

Fixed-rate revaluation

Fixed Rate Revaluation depends mainly on the member's Date of Leaving, and it will be the same revaluation each year until the GMPA, or Death if earlier. This approach is very common under private pension schemes, as it gives a predictable liability rather than an open-ended commitment linked to movements in national average earnings.

Date of termination of C/O employment	Fixed Rate of Revaluation
6 April 2017 - 5 April 2022	3.5%
6 April 2012 - 5 April 2017	4.75%
6 April 2007 - 5 April 2012	4.0%
6 April 2002 - 5 April 2007	4.5%
6 April 1997 - 5 April 2002	6.25%
6 April 1993 - 5 April 1997	7.0%
6 April 1988 - 5 April 1993	7.5%
before 6 April 1988	8.5%

Table 3.1 - Fixed rate revaluation

In Table 3.1, can be observed that a member that leaves the schemes with a preserved pension on 18 November 2004, and reaches their GMP Age on 29 December 2019, will have a revaluation rate of 4.5% per year and the GMP at GMPA is:

$$GMP_{GMPA} = GMP_{DOL} \times (1 + 0.045)^{2019-2004} \quad (3.3)$$

With GMP_{DOL} being the pension calculated at the date of leaving.

Limited rate

This option was withdrawn on 6th April 1997, however, this can remain for members who left contracted-out employment before that date. The GMP amount calculated at the date of leaving should be increased by the lower between:

- 5% compound for each complete tax year after the tax year that the member left contracted-out employment, up to and including the tax year before GMPD, or death if earlier;
- The percentage relevant to the tax year of leaving is shown in the section 148 order issued in the last complete tax year before the tax year in which GMPA is reached, or death if earlier.

The remaining pension elements are also getting revalued usually following fixed rates or specific index rates until the member reaches their date of retirement or death, if earlier.

3.1.2. GMP Increases

After reaching the GMPA the member is entitled to receive their GMP pension, which will then get increases that usually follow inflation changes. Currently, statutory increases follow Consumer Price Index (CPI) as a reference from 2011, before the Retail Price Index (RPI) was used. Regarding Pre 88 GMP the state is responsible to pay all the increases, while for the Post 88 GMP, the scheme pays the CPI up to a maximum of 3%, as presented in ANNEX 2 and the state should provide the remainder.

From a scheme perspective, to calculate the current pension (P_{Curr}) for a Pensioner, it should be calculated as:

$$P_{Curr} = \sum_{x=1}^X (E_x \prod_{i=n}^N (1 + I_{x,n})) \quad (3.4)$$

Where:

x – The correspondent element that is being calculated, $x = 1, \dots, X$; with X being the number of different elements of the pension;

E_x – The value of the element x calculated at the first payment date;

n – Year of the payment, $n = 0, \dots, N$; with N being the number of years between the first payment year and the current date;

$I_{x,n}$ – The correspondent increase rate of the element x in the year n

3.2. GMP RECTIFICATION

After getting the GMP Reconciliation done, trustees must focus on GMP Rectification, which includes:

- Identify which members' pensions need rework;
- Decide how to put those revised benefits into payment.

However, some things can be done before starting to ease the process and are most likely to reduce the analysis scope.

3.2.1. Data Validation

It is fundamental to this phase that administrators check if the latest data is being used, so scheme records show the most accurate results possible. Sometimes Reconciliation process takes a considerable length of time, it may lead to HMRC having different data between two extracts.

When checking the data, especially for Dependants, it can be difficult to find the right information due to some data gaps such as basic details not being recorded, the original member not linked with the Spouse, service dates missing, or even contribution amounts.

For some members, it may not be possible to make a reasonable analysis, but for this Rectification work, there is often sufficient data to make the necessary adjustment to members' pensions.

3.2.2. Initial Analysis and Scope

In this phase, the goal is to compare the data obtained by administrators in the scheme and the HMRC GMP figures. The scope of analysis is composed by:

Deferred members, will have their GMP compared at the date of leaving;

Pensioners (Retirements), the comparison is at the current date, the current pension in payment;

Dependants, just like Pensioners will have their pension compared to the current date.

There are some situations where trustees can reduce the Scope that will proceed to the Rectification work by excluding some cases that:

- Rectification will have no impact on the members' pension and will be classified as **No Further Action** (NFA);
- HMRC has no evidence of any liability with the member, it may be due to transfer out, trivial commutation or taken refunds will be **Excluded** from the analysis;
- Has insufficient information to make the right decision, these cases are normally sent back to the administrators' team as a **Query**, so they can explore what could have happened and what should be done to that specific case.

The goal for those who do not have the same GMP on both sides is to see which one is correct, which is sometimes done by discovering which one is wrong, for example:

- Different revaluation rates are used in scheme data, usually between S148 orders and fixed rate;

- Members with no GMP in payment. When a member retires earlier than the normal retirement age, the amount of GMP is paid together with Excess, but following Excess increases, until reaching their GMP Age. This step of putting the GMP in payment is not automatic and some members might never receive their GMP, which may lead to an increase in pensions to be rectified;
- If some of the sides are at zero GMP, it is important to look at Reconciliation to see if there was any transfer of benefits or reimbursement.

For those that are considered wrong in scheme records, it is important to identify the right Excess element that refers to the Pre 97 pension before proceeding with a phase of rework. This percentage is expected to be around 10% to 15% of the total cases.

3.2.3. Rebalance

For Deferred cases, where the pension isn't in payment yet, there will be only some adjustments between splits made at members' date of leaving. The scheme GMP is replaced by the HMRC amount and the difference will be deducted from the amount of the Excess.

Source	Pre 88 GMP	Post 88 GMP	Excess Pension	Total Pre 97 pension
Scheme	£55.4	£60.1	£108.3	£223.8
HMRC	£83.8	£90.9	-	
Rebalance	£83.8	£90.9	£49.1	£223.8

Table 3.2 - Rebalance standard case (weekly pension)

$$New_{Excess} = Old_{Excess} + Old_{GMP} - New_{GMP} \quad (3.5)$$

The example explains how to rebalance a deferred member. In case GMP values provided by HMRC are accepted, it is required to change the scheme values according to what is correct. In this case, the GMP is equal to what is indicated by the HMRC and the GMP difference between the two sources is applied to the value of the Excess element.

For Pensioners and Dependents, it must be confirmed in advance with the admin which tolerance levels to apply when it comes to differences in the amount of GMP as it can become too expensive to proceed with the Rectification work for all members. Therefore, some schemes define a limit in which if the GMP does not exceed, the Rebalance process is applied, as in deferred members.

In cases where the Excess isn't enough to cover the GMP difference (when it turns into a negative value), it should be confirmed with Trustees if the pension accrued after 1997 can be used to cover the difference. When this is not possible, the most viable solution is to uplift the pension. See an example below:

Source	Pre 88 GMP	Post 88 GMP	Excess Pension	Total Pre 97 pension
Scheme	£22.2	£36.4	£19.9	£78.5
HMRC	£50.0	£31.9	-	
Rebalance	£50.0	£31.9	-£3.4	£78.5

Table 3.3 - Rebalance uplift case (weekly pension)

As noted in the example, the existing Excess element is not sufficient to cover the difference and, if there is no other eligible element for rebalancing, an Uplift must be applied to leave the pension only with £50 Pre 88 GMP, £31.9 Post 88 GMP with a total of £81.9 per week, in this case.

Assuming that a rebalance is just an adjustment between elements of a pension at the last calculation date, the sum of elements will be the same as before, except in uplift cases, where the new pension is higher than the old one, but now with the different amount in GMP and non-GMP benefits that will get different revaluations and increases in the future.

3.2.4. Rectification

For pensions in payment which were decided to suffer a rectification work, there are different ways to do it, the most common ones are:

Delta approach, the one that will be used in this project, where the pension is adjusted in a different time instance, such as the date of leaving or the members' GMP date. The pension benefits will get a "rollback" to a previous date and the adjustment between elements will be made there. After that, the benefits will get the corresponding revaluations and increase back to the current date.

In the following example, it is possible to understand how to execute the delta approach.

- **Date of Birth:** 01/11/1940
- **Gender:** Male
- **Date of Leaving:** 15/06/1999
- **GMP Revaluation rate:** Fixed
- **GMP increases:** statutory (CPI 3%)
- **Excess Revaluation rate:** CPI 5%
- **Excess Increases:** Fixed 3%
- **Correct pension from:** Date of Leaving

In contrast to rebalancing, in rectification, the total current pension is not the same and may vary positively (underpayment) or negatively (overpayment).

Current Date	Pre 88 GMP	Post 88 GMP	Excess Pension
Scheme	£12.1	£53.4	£98.1
HMRC	£14.7	£42.9	-
Rectified	£14.7	£42.9	?

Table 3.4 - Rectification case - initial pension

Assuming it is a Normal retirement and knowing that the member's GMP Age is 65, his GMP Date is 01/11/2005, which means the member is getting his first increase on 6th April 2006, the tax year 2005/06. In total, the member will get 16 increases until the current tax year 2021/22.

Following the statutory increases table which follows RPI 3% before 2011 and CPI 3% on and after that year for Post 88 GMP and is null for Pre 88 GMP, the pre 97 pension at GMPA would be calculated as:

$$Pre\ 88\ GMP_{GMPA} = Pre\ 88\ GMP_{Current} \ ; \ Post\ 88\ GMP_{GMPA} = \frac{Post\ 88\ GMP_{Current}}{GMP\ increases} \quad (3.6)$$

The same procedure as Post 88 GMP to Excess element, where cumulative GMP increases are 1.41821219 (taken from ANNEX 2) and Excess increases are 1.60470 (using fixed 3%).

GMPA	Pre 88 GMP	Post 88 GMP	Excess Pension
Scheme	£12.10	£37.65	£61.13
HMRC	£14.70	£30.25	-

Table 3.5 - Rectification case - pension at GMPA

Secondly, to correct the pension at the Date of Leaving, the pension will need to suffer another rollback, this time regarding the revaluation period. In this example, from the tax year 2005/06 until the first revalued tax year 2000/01, this being a total of five years of revaluation.

$$GMP_{DOL} = \frac{GMP_{GMPA}}{GMP \text{ revaluation}} ; \text{Excess}_{DOL} = \frac{\text{Excess}_{GMPA}}{XS \text{ revaluation}} \quad (3.7)$$

Using now the previously shown table of GMP Fixed revaluation, with DOL = 15/06/1999, the revaluation to use is 6.25% per year to a total of 1.3540812 and the Excess revaluation is 1.0720667

Giving the pre 97 pension at the Date of Leaving as:

DOL	Pre 88 GMP	Post 88 GMP	Excess Pension
Scheme	£8.94	£27.80	£57.02
HMRC	£10.86	£22.34	-
Rebalance	£10.86	£22.34	£60.56

Table 3.6 - Rectification case - pension at DOL

As it is already known the GMP values at the Current date, it is now time to calculate the Excess pension, applying the same revaluation and increases (in the way around), reaching the total of:

Current date	Pre 88 GMP	Post 88 GMP	Excess Pension	Total Pre 97 pension
Scheme	£12.1	£53.4	£98.1	£163.6
HMRC	£14.7	£42.9	-	
Rectified	£14.7	£42.9	£104.2	£161.8

Table 3.7 - Rectification case – rectified pension

In this example, the rectification work results in a decrease of £1.8/week on the current pension in payment.

Full rework of benefits, make a more accurate benefit rectification so trustees should make individual manual calculations to find the new pension from the date of leaving onwards. There are a few cases where the Delta approach might work better, e.g. when there is insufficient information available to recalculate the pension from scratch.

Regarding the output, after the pension gets recalculated, the current pension will not be the same. It can then lead to two different results.

Overpayment - the new pension is lower than the old one. Member should have received less benefit than it was receiving.

Underpayment - the new pension is bigger than the old one. Member was getting less benefit than he should be entitled to. These cases are quite problematic and in most cases, the scheme pays all the benefits that the member didn't receive before.

There is the last method called **the forward-looking approach**, being easier to apply, this approach splits the current pension as it was done on a rebalance, regardless of the tolerance levels. This approach might be easily challenged by members as it neither fixes historic over/underpayments nor gives the correct pension in the future.

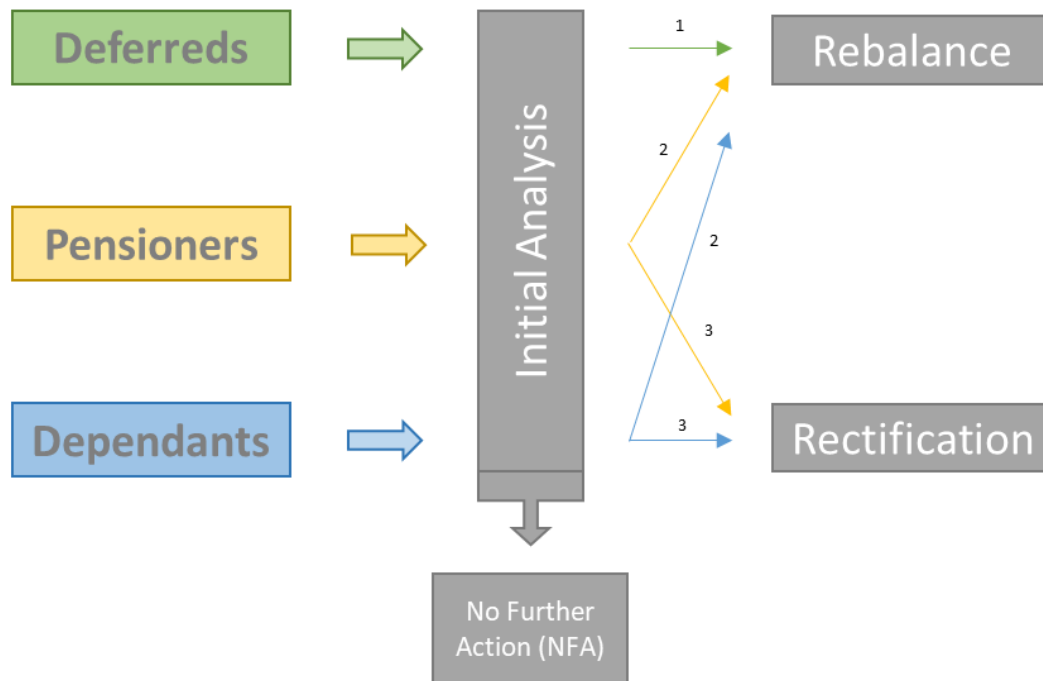


Figure 3.2 - Rectification process

Summing up, as presented in Figure 3.2, regardless of the discrepancy between the GMP from the scheme and HMRC, the deferred pensions that require pension changes will suffer a rebalance to their benefits (1), such as the pensions in payment (pensioners and dependants) which the difference is within the tolerance decided by the scheme (2). The remainder members requiring recalculation of their GMP will follow one of the referred approaches to get the new benefits at the current date (3).

3.3. PENSION WEALTH VARIATION

After getting the Current Pension amount, each element will be revalued until the member's Guaranteed Minimum Pension Age (GMPA) or Date of Retirement (DOR), depending if it is GMP or Excess element, only for deferred members, and everyone will then get the correspondent increases until their estimated life expectancy. The Pension Wealth (W) is calculated by the sum of every annuity the member is getting in the future from the day the data is being analysed, excluding original members' future dependant benefits. It can be calculated using the following formula:

$$W = \sum_{x=1}^X W_x \quad (3.8)$$

With W_x being the Pension Wealth portion for a specific element x . Since the pension is made up of different elements that follow distinct increases, an individual calculation must be made on the total value of each one in Pension Wealth, which is obtained by the following formula:

$$W_x = \sum_{i=n}^N A \times (1 + I_{x,i}) \quad (3.9)$$

Where:

x – The correspondent element that is being calculated, $x = 1, \dots, X$; with X being the number of different elements

A – The value of the next payment coming from this element

i – Year of the payment, $i = n, \dots, N$; with n being the year of the next payment and N the last payment before the member reaches their estimated life expectancy.

$I_{x,i}$ – The correspondent increase rate of the element x in the year i

The final step of this project is to analyse the variation between the Pension Wealth amounts before and after the rectification work, and group the population so it is possible to understand which groups were more affected.

3.4. LIFE EXPECTANCY

To calculate Pension Wealth, it is necessary to set a "limit" in members' lives. For that, it was used the Life Expectancy as a metric to define where the scheme stops payment to their members.

Instead of modeling the life expectancy, it was decided to use existing data from a public database due to the following reasons: there is already very trusty information on this and to not extensively work on a topic that gets off too much of the main goal which measures the impact of the rectification process. In this work, only schemes from the United Kingdom are being considered, for that reason, it will be used specific mortality tables for that region.

3.5. INFLATION RATE

Pension increases usually follow common inflation indexes such as Consumer Price Index (CPI) or Retail Price Index (RPI). These are published within the following two to four months and are based on the annual difference in market prices.

To forecast the behavior of price indexes, there are several models to predict future rates. In this case, an Autoregressive Integrated Moving Average (ARIMA) model will be used. ARIMA is a specific subset of univariate modeling, it expresses a time series in terms of past values of itself (autoregressive component) plus current and lagged values of a "white noise" error term (moving average component).

ARIMA model notation is ARIMA (p,d,q), with p being the number of autoregressive terms, q being the number of moving average terms and d denotes the number of times a series must be differenced to induce stationarity.

$$\Delta^d CPI_t = \sum_{i=1}^p \beta_i \Delta^d CPI_{t-1} + \sum_{i=1}^q \alpha_i \mu_{t-1} + \mu_t \quad (3.10)$$

Or can be written as:

$$\Delta^d CPI_t = \sum_{i=1}^p \beta_i \Delta^d L^i CPI_t + \sum_{i=1}^q \alpha_i L^i \mu_t + \mu_t \quad (3.11)$$

Where Δ is the difference operator, vector $\beta \in R^p$ and $\alpha \in R^q$

This model includes advantages and disadvantages as below:

Advantages

- Requires data on the time series only;
- Great for forecasting a large number of series;
- Avoids problems that may occur on multivariate models with different periods provided. ARIMA uses conditional forecasts based on forecasts of unavailable observations.

Disadvantages

- ARIMA models are essential 'backward looking', which means that, they are generally bad at predicting turning points, like the COVID-19 pandemic or Ukraine invasion, unless the turning point represents a return to long-run equilibrium.
- Some traditional techniques to measure the reliability of the chosen model are very subjective and can depend on the experience of the forecaster.

4. DATA ANALYSIS

4.1. DATA

Scheme data was extracted from a database that contains several records of UK pension fund schemes. A previously executed scheme was chosen to avoid the risk of non-standard problems appearing. It is a defined benefit scheme, using fixed revaluation rate and statutory increases (CPI 3%). It has 6899 people to analyse, with 4394 deferred pensions, 2136 pensioners and 369 dependants/spouses. The date of extraction was October 2020 and Excel will be used as a work tool.

To estimate the life expectancy, mortality tables from *Office for National Statistics* for the United Kingdom region for the calculation date (2020) have been used.

First, it is necessary to check that the data is consistent, that the scheme values are on the same date as the HMRC figures, if there are any missing values and how to correct them. For spouses, if the original member is not found, it is automatically removed from the analysis and the case will be treated individually by the actuarial team.

4.2. INITIAL ANALYSIS

Subsequently, an Initial Analysis was carried out, this being the first major phase of the process, where it was decided what to do with each case, a comparison was made of the values of both parties, and an attempt was made to understand what type of errors could have happened so that the most recent GMP value was not correct.

After the analysis, the members were divided according to their classification, for Deferred, it was found that 84.6% of pensions should not be changed, 13.3% require an adjustment between the GMP and Excess values calculated on the date of exit from the scheme and 2.1% were excluded for lack of consistent data. For Pensioners, there are 85.6% of cases without any pension change, less than 1% excluded from the analysis, 8.75% of people with adjustments to the current pension amount and 5.2% of pensions where the correction was made. In the case of Spouses, 56.1% of the pensions were not changed, 30.3% were excluded, largely due to lack of information from the original member, usually in older cases, for instance, if the member dies before the system has been created, may not have put their information, 9.5% of cases went to rebalance to receive an adjustment and only 4.1% of pensions were rectified.

Table 4.1 shows the absolute values of the initial analysis performed and the around 950 cases that require any sort of rework will follow through the calculation stage.

Status vs Classification	No Further Action (NFA)	Excluded	Rebalance	Rectification	Total
Deferred	3719	90	585	---	4394
Pensioner	1828	9	187	112	2136
Dependant/Spouse	207	112	35	15	369
Total	5754	211	807	127	6899

Table 4.1 - Classification of different statuses after the Initial Analysis

4.3. REBALANCE

In the Rebalance, the pension adjustment was made using the HMRC GMP values, and in general, it was obtained that 51.7% of cases where the GMP increased, 46.8% where there was a decrease and the remaining 1.5% were just corrections in the split between Pre 88 GMP and Post 88 GMP (the total remained the same). In the cases where it increased, there were 10 cases where the Excess was not enough to cover the increase in the GMP and, therefore, the total value of the pension also ended up increasing.

Rebalance	No changes	GMP decreased	GMP increased Uplift	Total
Deferred	12	280	293 3	585
Pensioner	0	93	94 6	187
Dependant/Spouse	0	15	20 1	35
Total	12	378	417 10	807

Table 4.2 - Changes in Guaranteed Minimum Pension by status

4.4. RECTIFICATION

Then, the members that needed Rectification work were inserted in a macro tool in Excel that, filled in for each member the date on which the values were compared between the scheme and the HMRC and until when the pension should be rolled back, had the following results:

In Pensioners, 50% of cases were classified as underpayments, pensions where the amount paid to date was less than what it should have been, 43.8% in an overpayment, that is, cases where members received more than they were supposed to receive and, finally, 6.3% where the present value of the pension remained the same as before the correction. For Dependents, the output was 27% underpayments cases and 73% overpayments.

Rectification	No changes	Underpayment	Overpayment	Total
Pensioner	7	56	49	112
Dependant/Spouse	0	4	11	15
Total	7	60	60	127

Table 4.3 - Changes in total pension by status

4.5. INFLATION RATE ESTIMATION

To calculate the value of Pension Wealth, it was necessary to estimate the values of the indices used both in the revaluation period and in the period after reform, for this an Autoregressive Integrated Moving Average (ARIMA) model was used.

First, the model was created to estimate the CPI 3% index, with historic data from January 1960 to June 2020. The initial model is composed of the parameters obtained in the output of Figure 4.1 and it was decided to make an estimation year after year so that the following years were already taking into account the predicted years. The period initially foreseen was July 2020 - June 2021, in Figure 4.2, the green trace being the estimated values and the others being the limits to 5%. Subsequently, numerous predictions were made and it was concluded that, after a few years, the estimated value for this index would remain static very close to 0.7%.

```
ARIMA(1,1,1)
Coefficients:
      ar1      ma1
      0.7353 -0.4359
s.e.  0.0537  0.0701

sigma^2 = 1.882e-05: log likelihood = 2868.08
AIC=-5730.16  AICc=-5730.12  BIC=-5716.45
```

Figure 4.1 - CPI 3% - ARIMA model

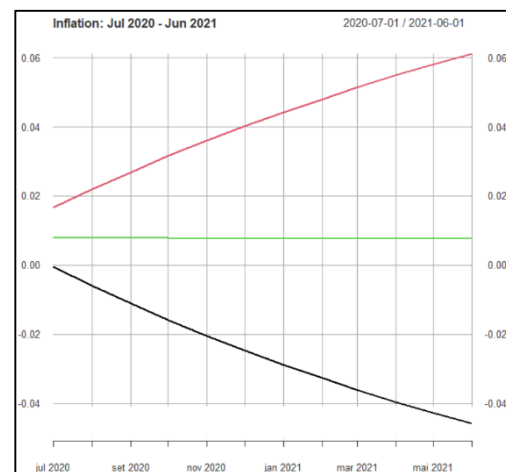


Figure 4.2 - CPI 3% - Estimate variation

Afterward, the estimation of the RPI 5% index followed, in the same way as the previous one. The same final value was reached, with this index also stabilizing at 0.7%. Despite being usually higher, this index is slightly more volatile and therefore ended up falling enough to stabilize at the same increase rate as the previous one. Below can be found the outputs of the ARIMA model and the estimation figures for the first year.

```
ARIMA(3,1,0)
Coefficients:
      ar1      ar2      ar3
    0.2412  0.1437  0.0944
s.e.  0.0373  0.0383  0.0377

sigma^2 = 2.601e-05:  log likelihood = 2753.33
AIC=-5498.67  AICc=-5498.61  BIC=-5480.39
```

Figure 4.3 - RPI 5% - ARIMA model

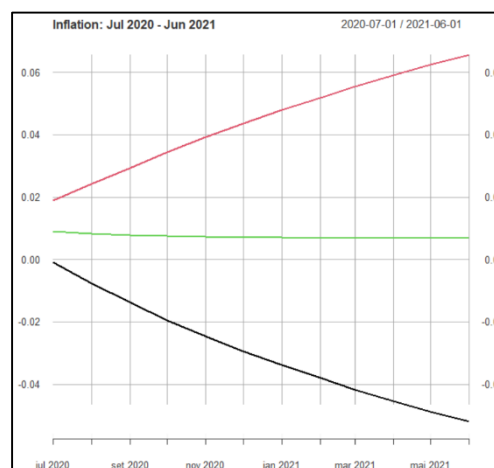


Figure 4.4 - RPI 5% - Estimate variation

4.6. DATA GROUPS

After the GMP rectification process was carried out, the population that underwent pension changes was studied by categories of analysis to understand the impact of this process on each one.

The analysis groups chosen were: Age, Gender, Service Duration, Revaluation rate and Increase rate. In Table 4.4, it is presented every category with different levels and descriptions.

Variables to measure the Impact of GMP Rectification on Pension Wealth			
Feature	Type	Levels	Description
Age in Deferred Pensions	Ordinal	[41-45[[45-50[[50-55[[55-60[[60-65[[65-72[	Age of pension holder at the time of data extraction
Age in Pensions in Payment	Ordinal	[48-60[[60-66[[66-72[[72-78[[78-84[[84-90[[90-100[	Age of pension holder at the time of data extraction
Gender	Nominal	Male (M) Female (F)	Gender of the pension holder
Service Duration	Ordinal	[0-3[[3-7[[7-11[[11-15[[15-19[[19-23[[23-27[[27-31[[31-42[	Time from the moment the member joins the scheme until their date of leaving, in years.
Revaluation rate	Numeric	8.50% 7.50% 6.25% 4.50% 4.00% 4.75% 3.5%	The revaluation rate is applied to the GMP, per year, until the member retires.
Increase rate	Nominal	CPI 5% Fixed 3% Fixed 5% LPI No Increase RPI 5%	Type of the increase rate applied into the Excess, per year, after the member retires.

Table 4.4 - Variables to measure the Impact of GMP Rectification on Pension Wealth

Age

Assuming that deferred members are younger than members in payment, it was decided to make this categorisation separate between preserved pensions and pensions that are already in payment.

For preserved pensions, the average age was 54.69 years, with a minimum age of 41 and a maximum of 72. In pensions in payment, including Pensioners and Dependants, the average age was 73.04 years, with a minimum and maximum age of 48 and 99 years, respectively.

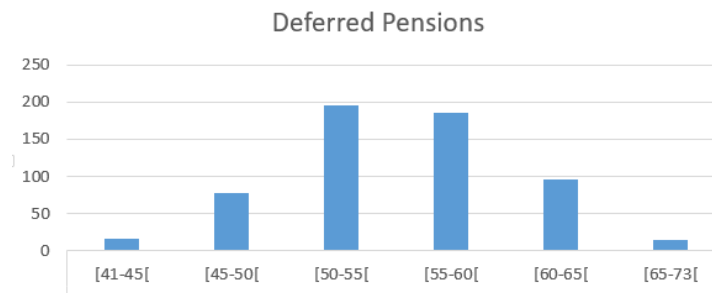


Figure 4.5 - Age groups in Deferred Pensions

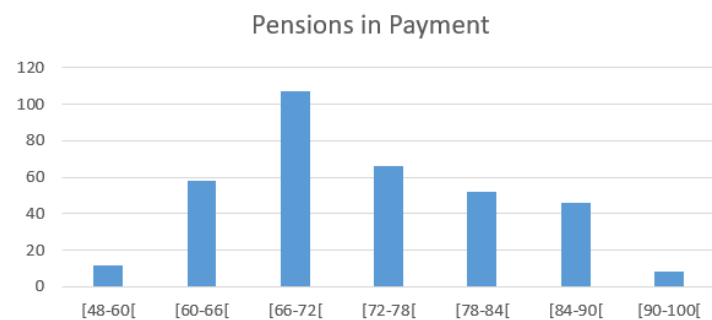


Figure 4.6 - Age groups in Pension in Payment

Gender

From previous knowledge, it is known that in most schemes the population is mostly male and, consequently, the Dependants are mostly female. In this case, these discrepancies were more visible in the deferred and dependant members but people were grouped according to their gender regardless of their status, the sample has 579 male and 355 female people.

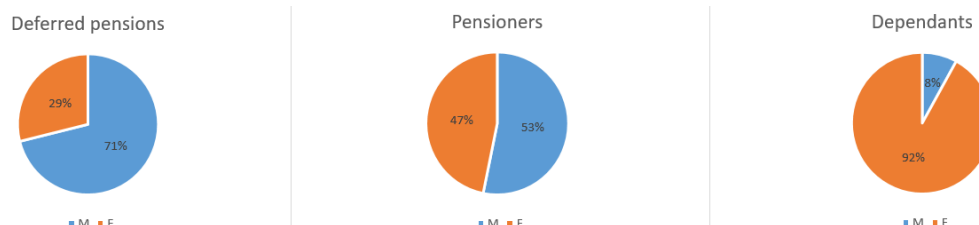


Figure 4.7 - Gender distribution by status

Service Duration

The length of service is one of the variables that most directly contribute to the increase in the pension, since the longer a person is in the scheme, the greater the contribution made to the fund, therefore, this variable was selected as a differentiating variable. It was observed that the minimum duration was only 4 months and the maximum of 41 years and 7 months and with an average value of 11 years and 2 months.

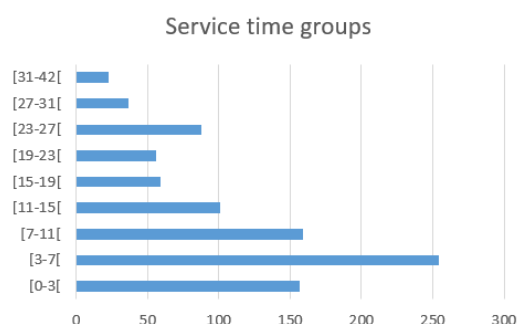


Figure 4.8 - Service duration groups

Revaluation Rate

This variable depends directly on the Date of Leaving of each person, remembering that the fixed revaluation rate was used in the GMP and that the Excess rose at the Consumer Price Index with a maximum of 5%, it is suspected that this would be one of the variables with most visible impact in the changes. Below can be found a figure with ordered revaluation from the older one to the newer one, in terms of the date of leaving.

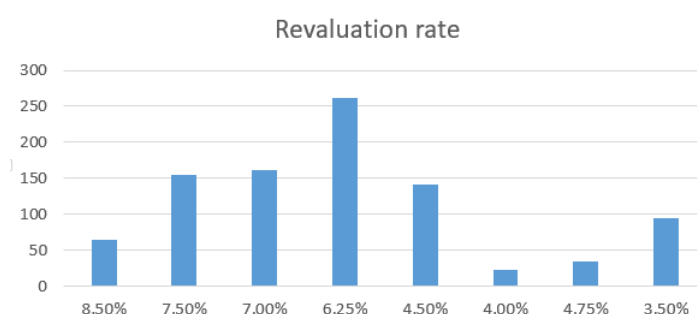


Figure 4.9 - Revaluation rate groups

Increase rate

To belong to different benefit tiers, larger increases in the pension are normally defined for members who held higher positions while employed, hence the different increase rates between members, which can be fixed (3% or 5 %), follow a certain index (CPI – Consumer Price Index, RPI – Retail Price Index, LPI – Limited Price Index) or null.

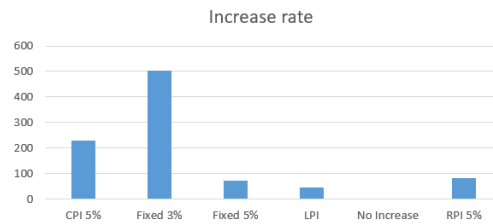


Figure 4.10 - Increase rate groups

4.7. RESULTS

Age

As mentioned earlier, the analysis groups for age were divided by status, deferred pensions and pensions in payment.

There are three moments of analysis:

- The retirement period (1), consisting of the time interval in which people in the analysis group are expected to retire (GMP – 65M/60F and XS – 65 years to everyone);
- The intermediate period (2);
- The pension cessation period (3), when people reach the average life expectancy and are estimated to die.

Note: The retirement and cessation periods mustn't be misinterpreted. While the intermediate period constitutes the behavior of the group when all members are in payment, the others show several ups and downs due to the entries and exits of the members as obligations to the scheme.

Deferred Pensions

About deferred pensions, it is known that in 2020 the fund still does not have any financial obligation to members, but assuming that the "over GMPA" members who belong to the group [65-73[for men and groups [60-65[and [65-73[for women, retire immediately, along with the rest who reach this age in 2021, these age groups are expected to present an obligation to the scheme in the year 2021.

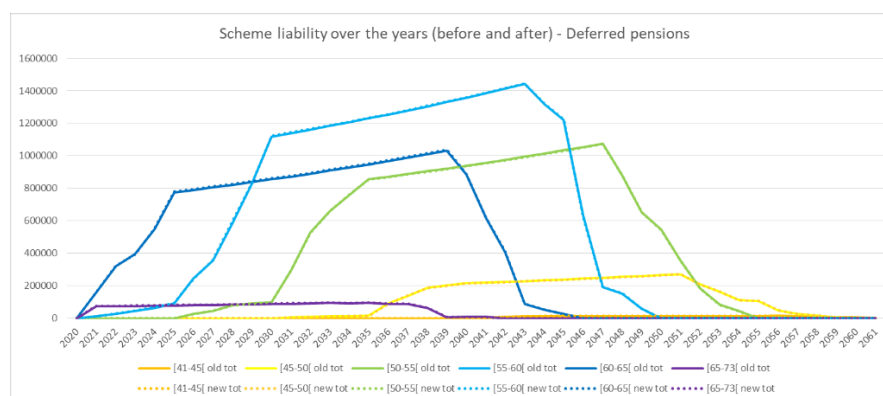


Figure 4.11 - Scheme total liability by Age groups - Deferred Pensions

Figure 4.11 shows the total amount payable to each age group of members per year before and after the amendment to the scheme. However, due to the large scale of the figures compared to the

absolute variation and also the vast number of groups it is not possible to analyse the differences in detail. Therefore, representative groups were selected to analyse relevant aspects in each category.

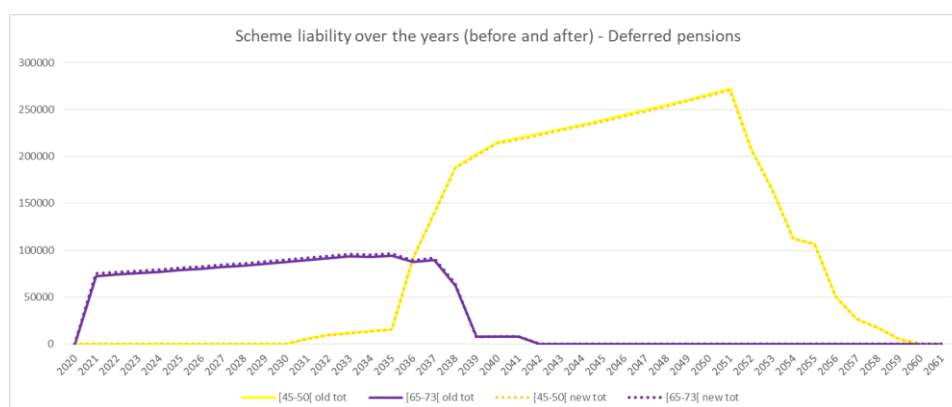


Figure 4.12 - Scheme total liability by Age groups - Deferred Pensions

Analysing two opposite groups in Figure 4.12, the ages [45-50[and [65-73[show some differences. The age group [65-73[includes only one increase in period (1) as it is being assumed that everyone retires in the next year (2021), while the other group has different increases over that period, since for a person belonging to the age group [45-50[, it is estimated that he/she will start receiving his/her pension between the next 10 and 15 years if it is a woman and the next 15 and 20 years if it is a man. After each group's retirement period, each member's pension continues to grow according to the respective pension increments during the period (2). Finally, when the average life expectancy, presented for the limits of both intervals analysed in Table 4.5, is reached, it is estimated that the member dies and ceases to be an obligation to the scheme. It will not be considered that the members' liability will pass to a Dependant as with the available data is not always possible to know if they are still alive or not.

Age	Male	Female
45	80	84
50	81	84
65	83	86
73	85	87

Table 4.5 - Life Expectancy by Age

From Figure 4.11, it is observed that the smaller groups are those of the extreme ages, however, when it comes to variations in pensions, the age factor can influence a lot. In the case of a drastic change in the current pension, it can cause a huge change to members' Pension Wealth, whether positive or negative, to an older person as it will have a high percentage impact in period (1) with no time to stabilize in period (2). On the other hand, a younger person will have a very unpredictable variation as this will not be mostly impacted by the initial variation, but also by the behavior/growth in the following years.

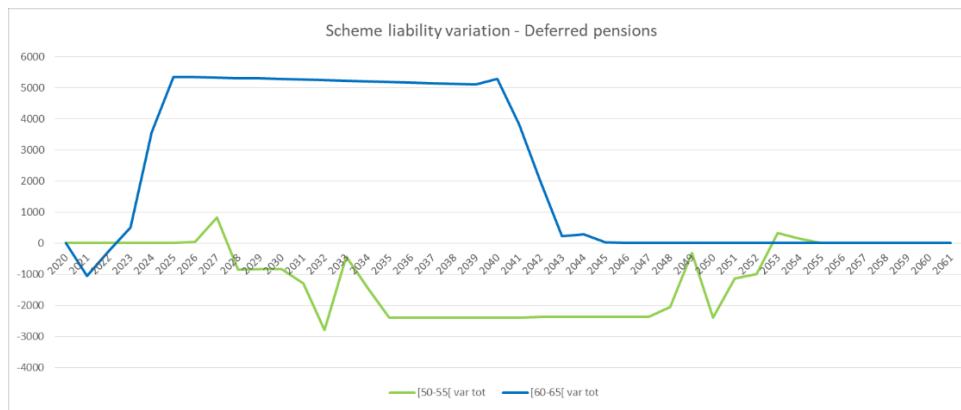


Figure 4.13 - Scheme liability variation by Age groups - Deferred Pensions

Analysing the variation between pensions before and after the correction shown in Figure 4.13, two representative groups were selected, age groups [50-55[and [60-65[. There are some differences between the two. Starting with period (1), the age group [50-55[includes 15 years for this period and, by the ups and downs during this period, it is clear that there are both people with pension reductions and increases, but overall, the group suffers a pension reduction of around -£2400 in the year 2035, the end of this group's retirement period, and during the period (2) this group remains quite stable. On the other hand, the age group [60-65[undergoes a significant increase during the period (1) reaching a maximum difference of £5350 in total pensions followed by a small reduction over the period (2).

This result is because the GMP has a much greater revaluation than the Excess, since, for this scheme, people can have their GMP growing, until retirement, between 4% and 8.5% fixed per year, while the Excess revalues at a variable rate (CPI) with a maximum of 5%. Therefore, according to Table 4.6, if the revaluation period is significant, an increase in the GMP may imply an increase in the pension.

Deferred pensions	No changes	GMP decreased	GMP increased	Total
[50-55[	1.6%	49.2%	49.2%	100%
[60-65[	0%	44.8%	55.2%	100%

Table 4.6 - GMP variation – Deferred Pensions

At the end of each category analysis, pensions in the scheme were analysed cumulatively. Figure 4.14 shows the pension values accumulated over the years and Figure 4.15 shows the respective accumulated changes.

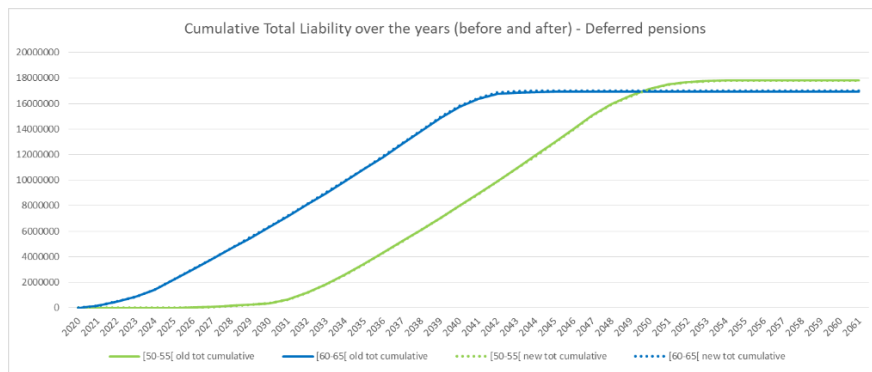


Figure 4.14 - Cumulative total liability – Deferred Pensions

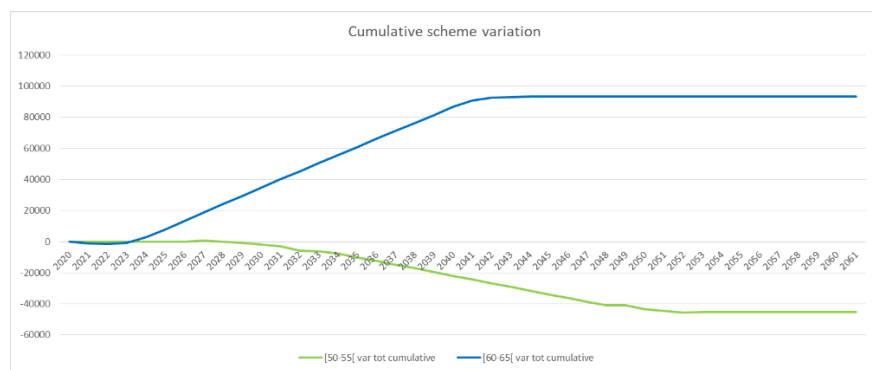


Figure 4.15 - Cumulative liability variation – Deferred Pensions

Pensions in Payment

For pensions in payment, which include Pensioners and Dependants, there is no retirement period, as all members are already receiving a pension. With this, special importance is given to the difference felt in the first year of analysis (2020), since from that moment on, an impact on the pension is already felt, which may increase or decrease depending on the behavior of pensions in the period (2).

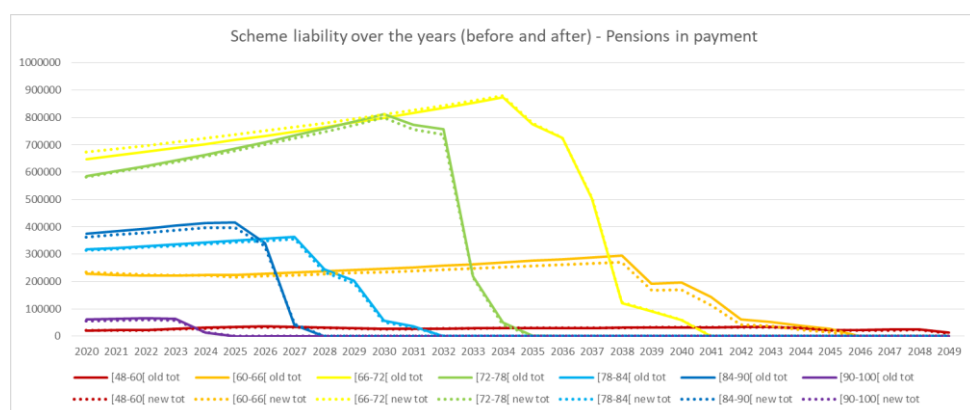


Figure 4.16 - Scheme total liability by Age groups – Pensions in Payment

In Figure 4.16, it is already possible to identify relevant differences between the old values and the recalculated ones. The absolute scale is smaller and, as these people are already retired, the seriousness of a pension being miscalculated is greater.

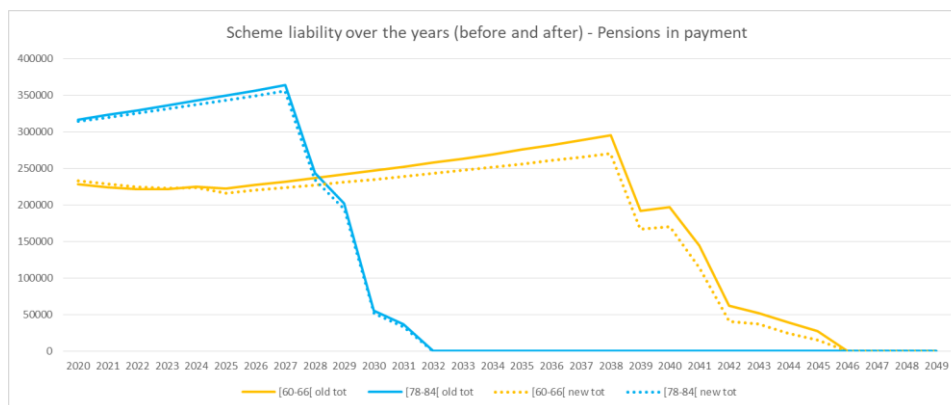


Figure 4.17 - Scheme total liability by Age groups – Pensions in Payment

In Figure 4.17, a small instability is observed in the first 5 years of the age group [60-66], this is because men are not yet entitled to receive their GMP, receiving it in the form of Excess, with different increases. On the other hand, the age group [78-84] lasts for a short time as they are closer to their average life expectancy, as can be seen in Table 4.7.

Age	Male	Female
60	82	85
66	83	86
78	87	89
84	90	91

Table 4.7 - Life Expectancy by Age

In Figure 4.18, for all ages, period (2) is decreasing in terms of pension variation, regardless of whether the initial variation is positive or not. Most people have a higher rate of increase in XS than in GMP, that is, an increase in the value of the GMP may imply that the pension increases in the revaluation period due to the higher rate in the GMP, however, in the period after retirement this can be reversed.

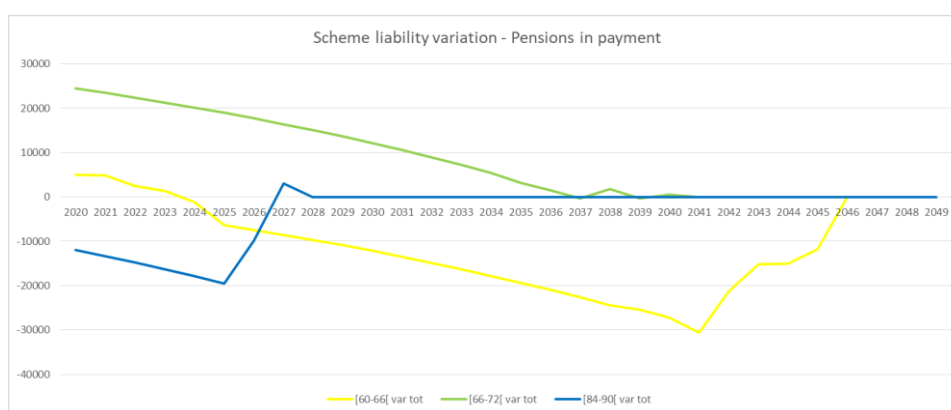


Figure 4.18 - Scheme total liability by Age groups – Pensions in Payment

Taking as an example three age groups with different characteristics, it is observed that the pre-retirement period will have been beneficial for the lower age groups in terms of pension growth compared to the old calculation, but that it may not be enough to compensate for the decrease felt in the post-retirement period as observed in the ages between [84-90] years.

Class/Year	2020	2030	2040	2049
[48-60[	-£ 719.01	-£ 1 485.31	£ 326.56	-£2 657.95
[60-66[	£ 5 065.18	-£12 163.38	-£27 254.03	-
[66-72[	£24 433.29	£12 137.30	£ 513.64	-
[72-78[	-£ 2 009.78	-£13 788.35	-	-
[78-84[	-£ 2 551.67	-£ 3 748.33	-	-
[84-90[	-£11 976.73	-	-	-
[90-100[	-£ 4 559.38	-	-	-

Table 4.8 - Age classes pension variation – Pensions in Payment

In Table 4.8, it is possible to identify a decrease in pensions over the years, except in the age group [48-60[consisting mostly of Dependants.

The figures below show the accumulated total pensions as well as the variations accumulated over the years. In Figure 4.20, there is a large decrease in the pension in the age group [60-66[, as there was a Dependant with a drastic increase in GMP, which has a much higher rate of increase in Excess means a very significant reduction in Pension wealth.

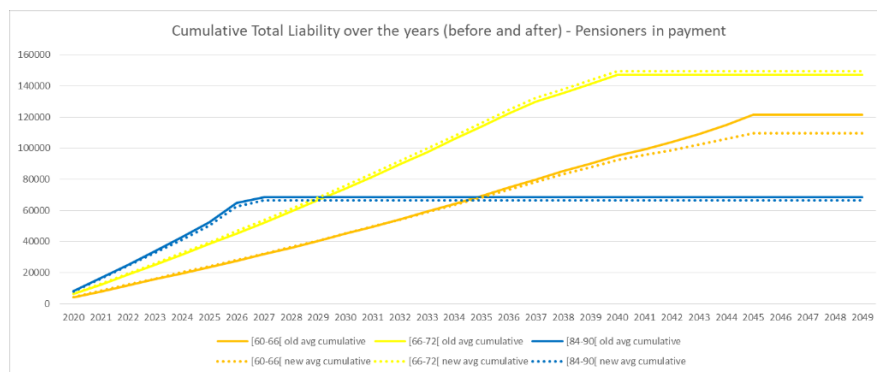


Figure 4.19 - Cumulative total liability – Pensions in Payment

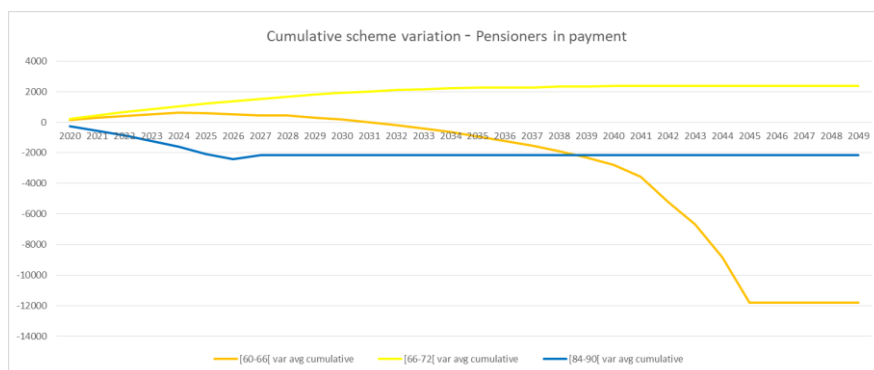


Figure 4.20 - Cumulative liability variation – Pensions in Payment

Gender

Most schemes that have GMP elements in the benefits portray pensions contributed in the 20th century, it is known that the male population usually has a greater weight in the scheme compared to the female group, which in turn implies the opposite in the Dependants. Furthermore, gender can be a differentiating factor when considering the existing differences regarding the GMPA (65 – men; 60 – women). At the same time, women used to have the possibility of retiring at 60 without any reduction

factor being applied to the pension. However, one of the most significant changes in the Lloyds case was that all people, men and women, now have a retirement age of 65.

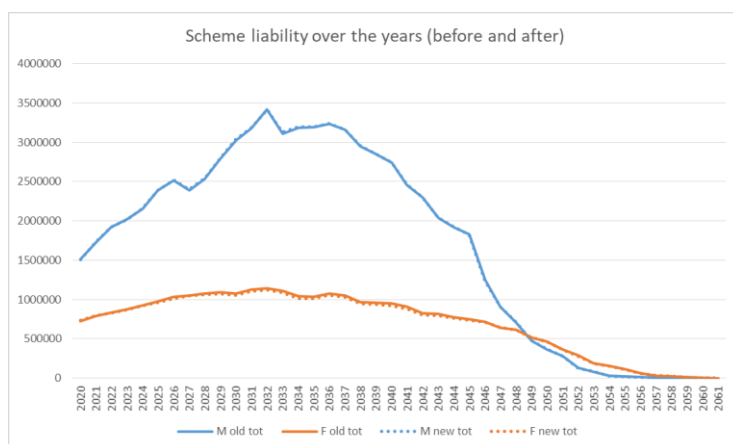


Figure 4.21 - Scheme total liability by Gender

From Figure 4.21, it can be seen that women start to have a higher total pension value after a certain point, because they live longer than men. Assuming the fixed age of 65, it can be stated that women live on average 14.5% longer than men, and this can also justify the fact that women's pensions exceed those of men in the year 2049.

Age	Male	Female
0	78.4	82.4
60	82.0	84.8
65	83.0	85.6

Table 4.9 - Life Expectancy by Age and Gender

Another reason that may justify this "exceeding" in the total pension amount is the fact that some Dependants are under 65 years old, being mostly women, which implies that their average life expectancy is higher and, consequently, pensions will last longer. Exclusively for Dependants, although they are already receiving the pension, including the GMP, they do not necessarily have to be retired, and some cases may already be receiving the pension at age 50.

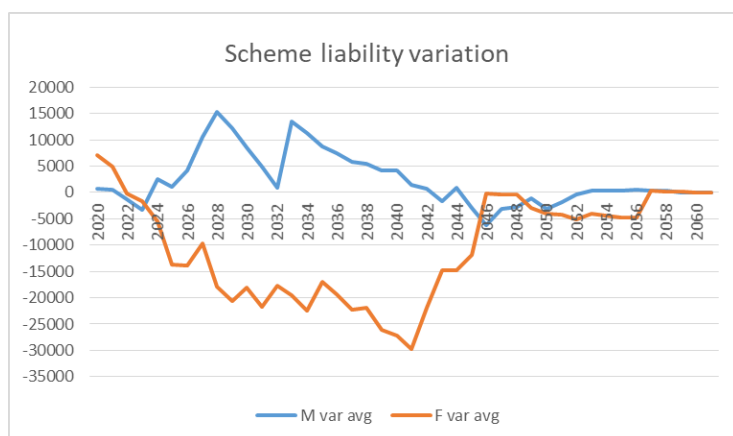


Figure 4.22 - Scheme liability variation by Gender

In Figure 4.22, different behaviors are observed between men and women, as was expected mainly due to the difference in the new retirement age, where women no longer receive a Late Retirement Factor on the entire pension but only on GMP related benefits if retire between the ages of 60 and 65, not forgetting that, almost certainly, this pension reduction in the Rectification process can be compensated later in the Equalisation exercise.

Below are the accumulated pensions and the respective variations in pensions for men and women.

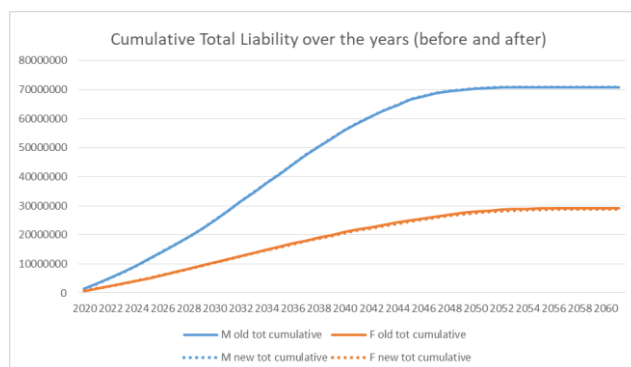


Figure 4.23 - Cumulative total liability

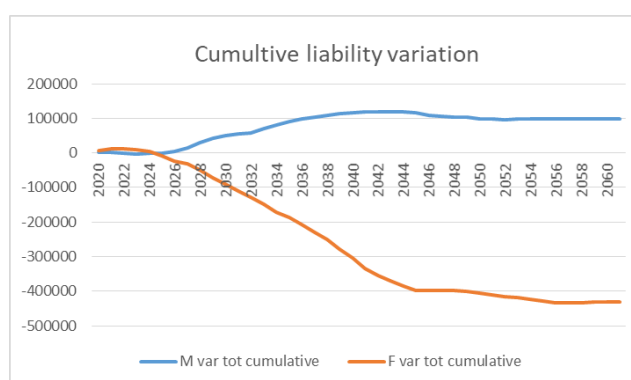


Figure 4.24 - Cumulative liability variation

Service Duration

As one of the variables that most directly contribute to pension growth, length of service is quite relevant for this analysis.

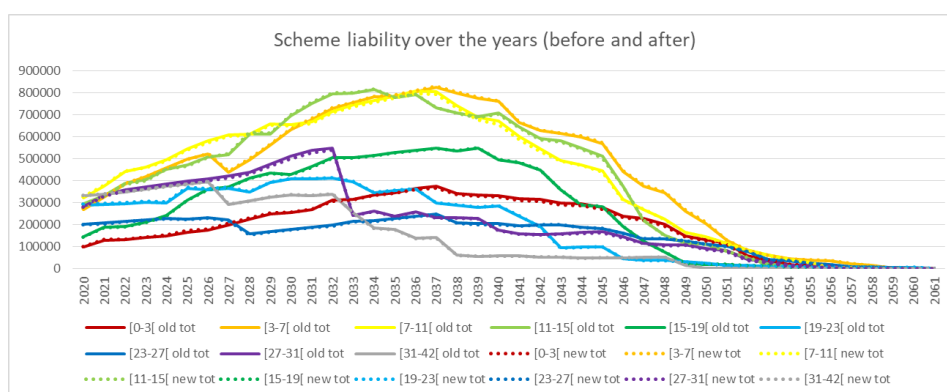


Figure 4.25 - Scheme total liability by Service Duration

In this differentiating variable, it is necessary to analyse pensions in two different ways, the average pension and the total pension of each group. Looking at the average obligation (per member) in Figure 4.26, would be expected that a lower service pension would have a lower total value, but since it is referring only to the Pre97 pension, this may not be the best interpretation in terms of concerns the comparison between two different services. For example, using the *Ceteris Paribus* method, a member with 1995-2015 service will not necessarily have a higher Pre97 pension than another member with 1990-2000 service, even with only half the duration, the second member's contribution will fall more on the period under review.

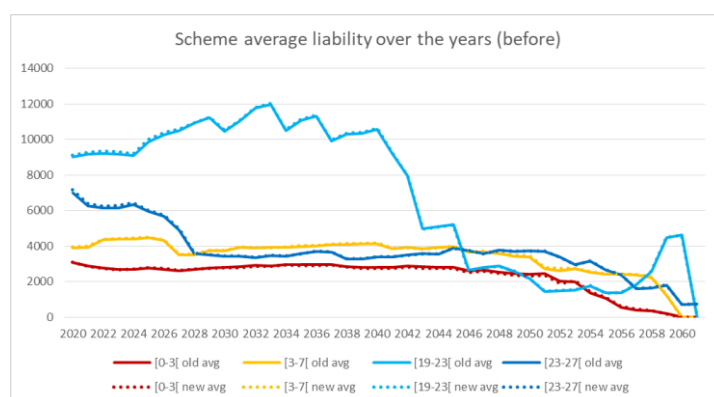


Figure 4.26 - Scheme average liability by Service Duration

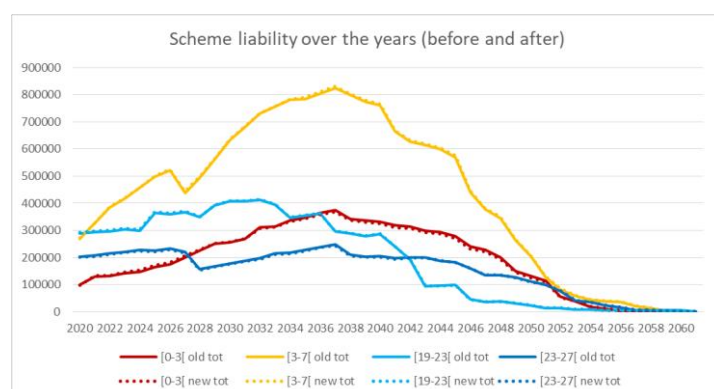


Figure 4.27 - Scheme total liability by Service Duration

Take as examples the duration groups [3-7] and [23-27], although one has an average of 5 times longer duration, both have similar values over the next few years. Furthermore, if services of identical duration are compared, such as groups [19-23] and [23-27], it is important to understand which elements make up each pension. The “weakest” element of the pension in the post-retirement period is known to be the Pre88 GMP, as it does not constitute any increase in that range, so if a member largely belongs to that period (1978-88), may imply lower pension growth. On the other hand, in Figure 4.27, the lowest duration groups are shown to be the ones with the highest total pension, this is mainly due to the greater number of people who belong to these groups, but also to the possible assumption that they will be younger people and may constitute a greater margin for growth.

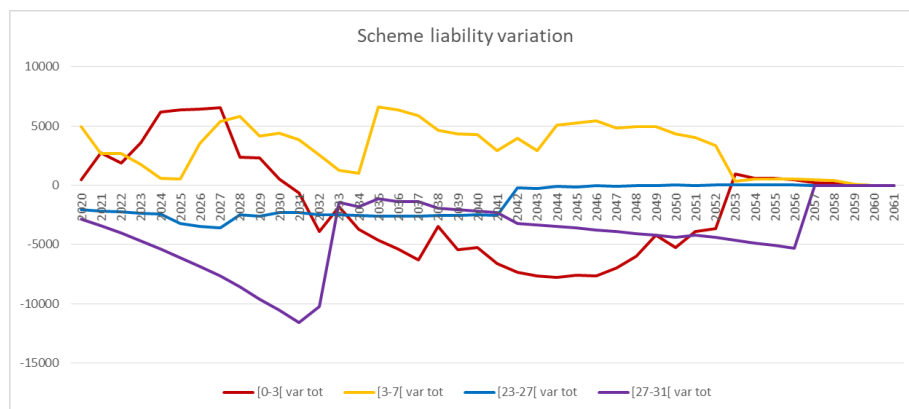


Figure 4.28 - Scheme liability variation by Service Duration

In Figure 4.28, there is an irregular variation over the years for most groups, a short-term rise is observed for groups with a shorter period of service, with a drastic reduction in all groups up to 15 years of service, with exception of the group [3,7[. On the other hand, in groups with longer periods of service, members suffer an initial reduction followed by a slight increase in the rest of the period, except the class [19-23[which is similar to the shorter services, starts with an increase in pensions decreasing over time.

Below are the cumulative total pension figures and the respective variations.

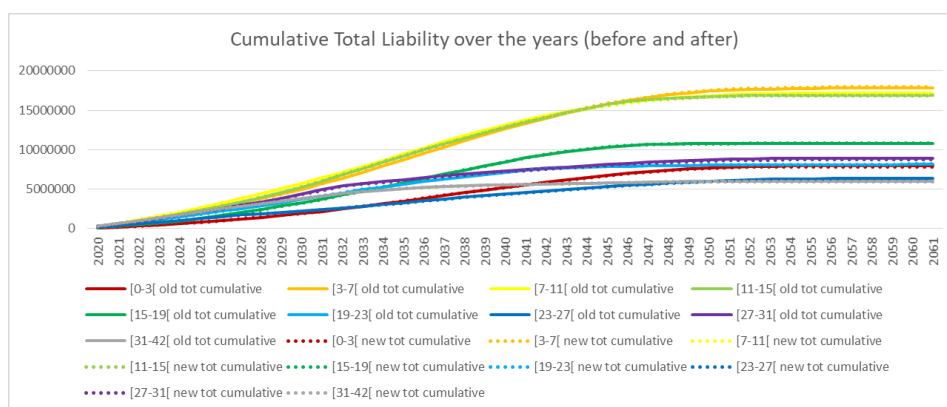


Figure 4.29 - Cumulative total liability

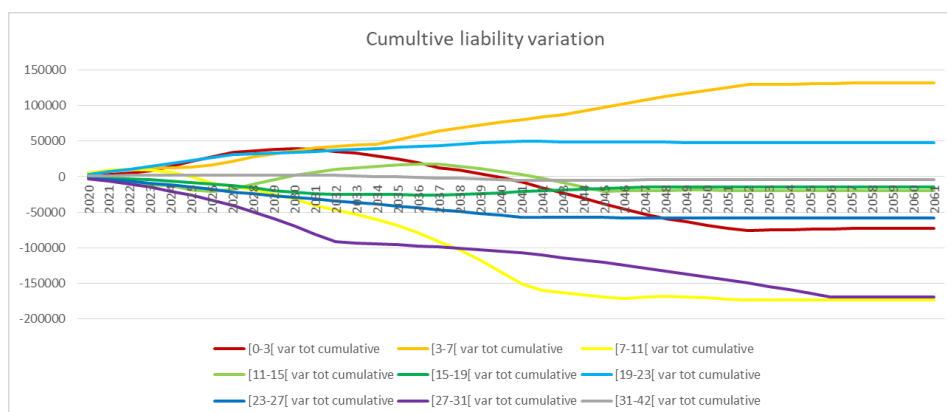


Figure 4.30 - Cumulative liability variation

Revaluation

The revaluation, as the name implies, is the rate at which each element of the pension grows before reaching the revaluation cut-off date. In this case, this date will be the GMP Date, since only GMP is being studied as the XS has a “fixed” revaluation of CPI 5% for all groups.

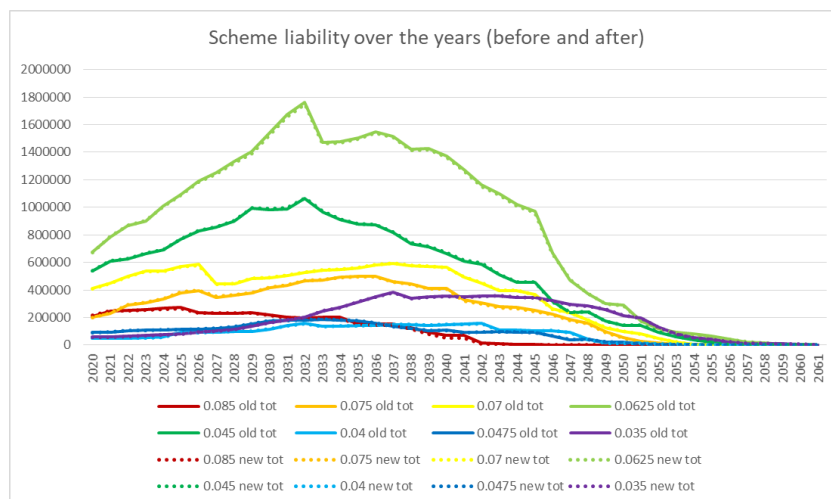


Figure 4.31 - Scheme total liability by Revaluation rate

Depending directly on the scheme exit date, this variable may be correlated with others, such as age or length of service. A group with a revaluation corresponding to an earlier departure date will have a higher average age, as can be seen in Table 4.10.

Age / Reval	0.085	0.075	0.07	0.0625	0.045	0.04	0.0475	0.035
[41-45[	0%	0%	0%	5%	0%	0%	0%	5%
[45-50[	0%	0%	7%	11%	6%	5%	0%	28%
[48-60[	0%	3%	1%	2%	1%	5%	0%	0%
[50-55[	0%	26%	22%	21%	18%	18%	11%	32%
[55-60[	3%	29%	20%	21%	14%	14%	26%	22%
[60-65[	9%	13%	9%	11%	10%	9%	6%	7%
[60-66[	16%	7%	4%	5%	9%	9%	6%	2%
[65-73[	3%	3%	1%	2%	1%	0%	0%	0%
[66-72[	22%	6%	11%	8%	18%	9%	40%	3%
[72-78[	13%	3%	6%	6%	13%	32%	11%	0%
[78-84[	13%	3%	6%	7%	9%	0%	0%	0%
[84-90[	16%	6%	12%	3%	0%	0%	0%	0%
[90-100[	6%	1%	1%	0%	0%	0%	0%	0%

Table 4.10 - Age vs Revaluation rate groups

Note: in the vertical column, the rows are divided by deferred pensions (lighter grey) and pensions in payments groups (darker grey).

Also, since only people who are entitled to GMP are being analysed, a more recent revaluation implies that the member will be contributing at least from 1997 to the date of withdrawal, which in this case indicates a longer period of service, as noted in Table 4.11.

Serv / Reval	0.085	0.075	0.07	0.0625	0.045	0.04	0.0475	0.035
[0-3[	17%	36%	27%	15%	6%	0%	0%	0%
[3-7[	31%	45%	37%	36%	9%	0%	0%	0%
[7-11[	33%	13%	17%	19%	27%	9%	0%	0%
[11-15[	16%	6%	6%	15%	21%	14%	6%	0%
[15-19[	2%	1%	5%	7%	11%	32%	14%	3%
[19-23[	0%	0%	3%	6%	8%	32%	26%	9%
[23-27[	0%	0%	3%	0%	6%	14%	34%	61%
[27-31[	2%	0%	1%	2%	6%	0%	9%	19%
[31-42[	0%	0%	2%	0%	6%	0%	11%	7%

Table 4.11 - Service Duration vs Revaluation rate groups

This differentiating variable is possibly where the greatest differences between the groups can be observed, since the older the revaluation, the greater the pension correction period and the impact, not only on the current pension values but also on the growth of Pension Wealth, as shown in Figure 4.32.

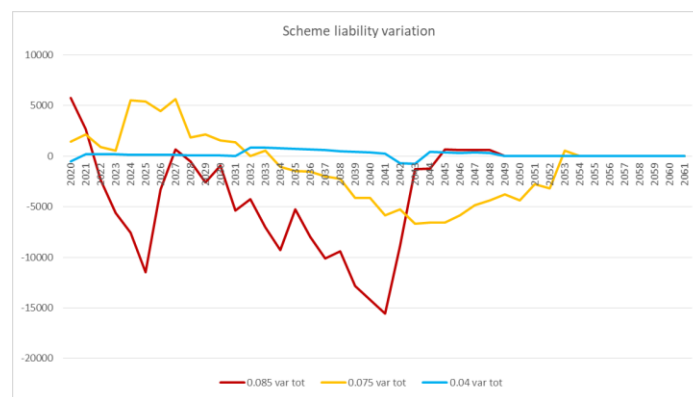


Figure 4.32 - Scheme liability variation by Revaluation rate

As expected, groups with revaluations corresponding to the oldest exit dates from the scheme (0.085 and 0.075) have very irregular variations throughout the entire reform period, while the most recent groups remain relatively constant.

Below are the cumulative total pension figures and their variations.

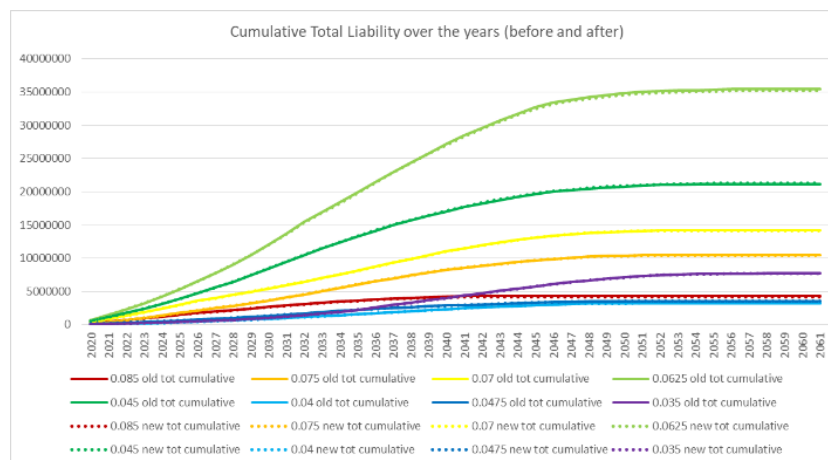


Figure 4.33 - Cumulative total liability

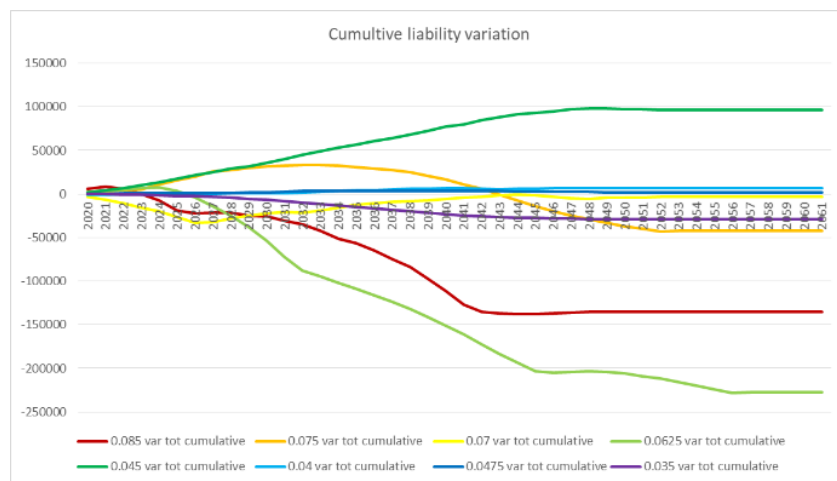


Figure 4.34 - Cumulative liability variation

Increases

Finally, the differentiating variable **Increase rate** follows, which refers to the increase applied to the Excess pension in the post-reform period. It is known that depending on the type of member, this part of the pension will have a greater or lesser value. A “regular” person will not get as significant a raise as a director or executive member of the company.

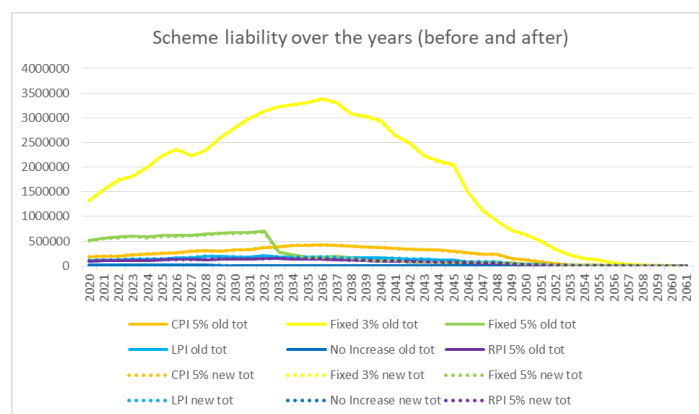


Figure 4.35 - Scheme total liability by Increase rate

Figure 4.35 shows a predominance of one of the classes over the others, it is understood that the regular class will be Fixed 3% and that the executive group will probably be Fixed 5%, in addition, other classes are created for members belonging to small groups to separate the type of benefits obtained, these mostly follow indices or simply do not constitute any increase in the pension in this element of the pension.

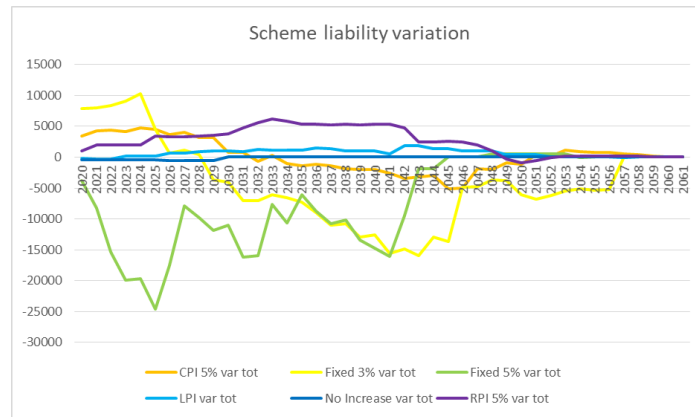


Figure 4.36 - Scheme liability variation by Increase rate

In Figure 4.36, the most common classes are also the most affected, in this case, negatively. On the other hand, the smaller classes suffer, in general, small positive changes except for the CPI 5% class, this is justified by the fact that the increases are greater or less than the increase in the GMP, the classes with a higher increase to the GMP (CPI 3%), tend to vary negatively, the opposite happens for the other classes since they have very similar or lesser growth.

Below are the cumulative total pension figures and the respective variations.

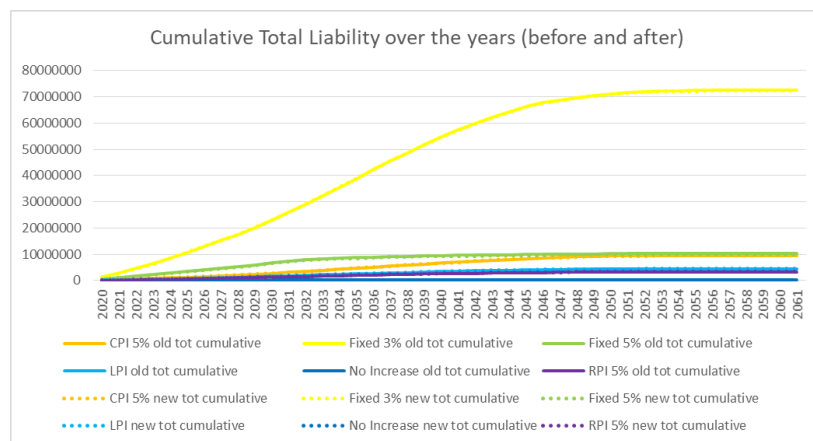


Figure 4.37 - Cumulative total liability

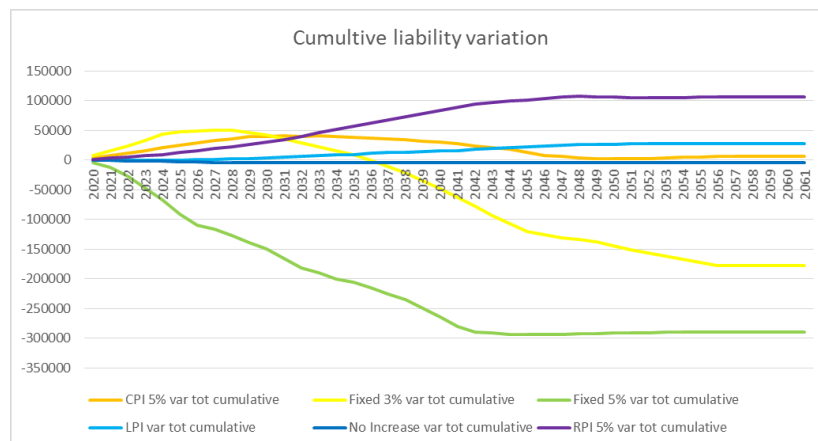


Figure 4.38 - Cumulative liability variation

5. CONCLUSION

The UK pension system is different from the vast majority of European countries, mainly in the composition of the pension for the period between 1978 and 1997, also known as the GMP (Guaranteed Minimum Pension) period. This element makes up an important part of people's pensions in this region, as it indicates the minimum amount to which they are entitled through the state.

It is of personal and legal interest that the pensions are calculated as would be indicated by the HMRC (Her Majesty's Revenue and Customs). Therefore, there are decision and recalculation processes in place to correct any mistakes made in the original calculation of the GMP value. These processes represent some stages of the GMP Journey. In this project, the second stage, GMP Rectification, was applied to represent practically the application of the method already used with the help of structured theoretical support. In addition, it was suggested to evaluate the impact of this process on people's pensions, not only at the current time of correction but also the variation of the pension in the long term until they reach their life expectancy, constituting the Pension Wealth.

For the application of the Rectification process, an old and already completed scheme was selected, so that no new problems or inconsistencies were found. The Rectification results were consistent and close to what was expected with about 14% of the population needing corrections in the pension calculation and 3% excluded due to a lack of fundamental information for the recalculation or due to inconsistencies felt between the system and the HMRC data.

Subsequently, to calculate Pension Wealth, it was necessary to estimate the behavior of pension growth rates through the ARIMA estimation method, which, based on the values obtained previously, regulates the expected values year after year, with confidence intervals of 5%.

Analysing the impact of the Rectification on Pension Wealth, by categorical groups, resulted in very significant conclusions in some cases. In terms of age, divided between deferred pensions and pensions in payment, it was observed that in the deferred pensions, the younger ages had a significant increase in the pension, while the older ages suffered a slight reduction. In the case of pensions in payment, it was quite similar to what happened in the case of deferred pensions, but only in the first years, since, over the years, this difference always tended to have a negative variation. In terms of gender, it is concluded that men are benefited in comparison to women, without forgetting that it is in the Rectification process and that, later, women will be compensated during the Equalisation phase. On the duration of service, it was concluded that it will not be the best variable to analyse the impact, since only the change before 1997 is being assessed, while recorded service applies to the whole pension. The revaluation was possibly the category with the most interesting results, as it is correlated with other categories. Groups corresponding to older departure dates are more impacted, as they imply a longer period correction. More recent dates tend to result in small variations in pensions. Finally, the increases in the excess pension are divided in terms of results, for the classes in which they are greater than the increase in the GMP, the pension tends to decrease and in the remaining classes, the value of the pension increases slightly.

In summary, this project work was important because we were able to apply in a clear and explanatory way all the stages of the GMP rectification process and understand how the people grouped by categorical groups are impacted, in this case, personal or specific characteristics of their private pension.

6. LIMITATIONS

About the GMP rectification process, sometimes the results of the initial analysis are not consensual with the reconciliation made previously, which can lead to members being excluded from the analysis to be analysed separately.

In the results, some schemes may not reach the same conclusions as the example shown in this work due to reasons such as population size, type of benefits, tolerance intervals, among others. Currently, there are already schemes where the rebalance is no longer applicable to pensions in payment and it is decided to rectify all members with differences greater than the tolerance.

In the case of larger schemes, such as the one studied, decisions tend to be made in bulk, to reduce the analysis time for specific cases that may need auxiliary calculations before a decision is made, e.g., in cases where the pension elements are not calculated on the same date, the members are included in the group to be corrected. Thus, the recalculation will only be carried out in the stages of rebalancing and rectification of the pension and may even indicate that it will not be necessary to correct the pension.

Regarding Pension Wealth, despite being the most correct approach, the fact that the future Dependants of the original members are not considered for the final value can be reflected in large differences in the observed values, in cases where the original member dies on a very far from life expectancy.

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8. ANNEXES

ANNEX 1 – s148 revaluation table

Tax year of earnings	Tax year of termination												
	19/20 %	18/19 %	17/18 %	16/17 %	15/16 %	14/15 %	13/14 %	12/13 %	11/12 %	10/11 %	09/10 %	08/09 %	07/08 %
1978/79	846.7	820.9	794.1	771.5	754.4	741.7	734.2	719.5	705.0	686.9	677.6	654.2	623.8
1979/80	735.6	712.8	689.2	669.2	654.1	642.9	636.3	623.3	610.5	594.5	586.3	565.7	538.8
1980/81	595.1	579.1	559.3	542.6	530.0	520.7	515.1	504.3	493.6	480.2	473.3	456.1	433.7
1981/82	454.8	438.7	422.2	408.2	427.6	419.8	415.2	406.1	397.1	385.9	380.2	365.7	347.0
1982/83	431.0	416.6	401.5	388.8	379.2	372.1	367.9	359.8	351.5	341.4	336.1	323.0	306.0
1983/84	393.1	379.6	365.7	353.9	345.0	338.4	334.5	326.8	319.2	309.8	305.0	292.8	276.9
1984/85	356.5	344.1	331.2	320.2	312.0	305.9	302.3	295.2	288.2	279.5	275.0	263.7	249.0
1985/86	328.3	316.6	304.5	294.2	286.5	280.6	277.4	270.7	264.2	256.0	251.7	241.2	227.4
1986/87	293.3	282.6	271.4	262.0	254.9	249.7	246.5	240.4	234.4	226.9	223.0	213.3	200.7
1987/88	266.2	256.2	245.8	237.1	230.4	225.6	222.7	217.0	211.3	204.3	200.7	191.7	179.9
1988/89	236.9	227.7	218.1	210.1	204.0	199.5	196.8	191.6	186.4	180.0	176.7	168.4	157.5
1989/90	204.0	195.7	187.1	179.9	174.4	170.3	167.9	163.2	158.5	152.7	149.7	142.2	132.4
1990/91	183.3	175.6	167.6	160.8	155.7	151.9	149.7	145.3	140.9	135.5	132.7	125.7	116.6
1991/92	157.3	150.3	143.0	136.9	132.2	128.8	126.8	122.8	118.8	113.9	111.4	105.0	96.7
1992/93	141.6	135.1	128.2	122.4	118.1	114.8	112.9	109.2	105.5	100.8	98.5	92.5	84.7
1993/94	130.1	123.9	117.3	111.8	107.7	104.6	102.8	99.2	95.7	91.3	89.0	83.3	75.9
1994/95	123.2	117.1	110.8	105.5	101.4	98.5	96.7	93.2	89.8	85.5	83.3	77.6	70.7
1995/96	113.8	108.0	101.9	96.8	93.0	90.1	88.4	85.1	81.8	77.7	75.6	70.3	63.5
1996/97	108.0	102.3	96.4	91.4	87.7	84.9	83.3	80.0	76.8	72.9	70.8	65.7	59.0
1997/98	98.1	92.7	87.1	82.3	78.8	76.1	74.5	71.5	68.4	64.6	62.7	57.8	51.4
1998/99	89.4	84.2	78.8	74.3	70.9	68.4	66.9	63.9	61.0	57.4	55.5	50.9	44.8
1999/00	81.7	76.8	71.6	67.3	64.0	61.6	60.1	57.3	54.5	51.1	49.3	44.8	38.9
2000/01	71.0	66.3	61.5	57.4	54.3	52.0	50.7	48.0	45.4	42.1	40.4	36.2	30.7
2001/02	64.4	59.9	55.3	51.3	48.4	46.2	44.9	42.3	39.8	36.6	35.0	31.0	25.7
2002/03	57.6	53.3	48.9	45.1	42.2	40.1	38.9	36.4	34.0	31.0	29.5	25.6	20.5
2003/04	52.1	48.0	43.7	40.0	37.3	35.3	34.1	31.7	29.4	26.5	25.0	21.2	16.3
2004/05	46.6	42.6	38.4	34.9	32.3	30.3	29.2	26.9	24.6	21.8	20.4	16.8	12.1
2005/06	40.8	37.0	33.0	29.6	27.1	25.2	24.1	21.9	19.7	17.0	15.6	12.2	7.6
2006/07	36.2	32.5	28.6	25.3	22.9	21.1	20.0	17.9	15.8	13.2	11.8	8.5	4.1
2007/08	30.8	27.2	23.5	20.4	18.0	16.3	15.3	13.2	11.2	8.7	7.4	4.2	
2008/09	25.5	22.1	18.6	15.5	13.3	11.6	10.6	8.7	6.7	4.3	3.1		
2009/10	21.6	18.4	15.0	12.1	9.9	8.3	7.3	5.4	3.5	1.2			
2010/11	20.3	17.0	13.6	10.7	8.6	7.0	6.0	4.1	2.3				
2011/12	17.6	14.4	11.1	8.3	6.1	4.6	3.6	1.8					
2012/13	15.5	12.4	9.1	6.3	4.3	2.7	1.8						
2013/14	13.5	10.4	7.2	4.5	2.4	0.9							
2014/15	12.5	9.4	6.2	3.5	1.5								
2015/16	10.6	7.6	4.7	2.0									
2016/17	8.8	5.7	2.6										
2017/18	5.9	3.0											
2018/19	2.8												

ANNEX 2 - Statutory Increases with a collar of 0% and a cap of 3%

Year	Statutory Increases	Cumulative	Cumulative from 2020
2022	1.03	1.03	-
2021	1.005	1.03515	-
2020	1.017	1.05274755	1.017
2019	1.024	1.07801349	1.041408
2018	1.03	1.1103539	1.07265024
2017	1.01	1.12145743	1.08337674
2016	1	1.12145743	1.08337674
2015	1.012	1.13491492	1.09637726
2014	1.027	1.16555763	1.12597945
2013	1.022	1.19119989	1.150751
2012	1.03	1.22693589	1.18527353
2011	1.03	1.26374397	1.22083173
2010	1	1.26374397	1.22083173
2009	1.03	1.30165629	1.25745669
2008	1.03	1.34070598	1.29518039
2007	1.03	1.38092716	1.3340358
2006	1.027	1.41821219	1.37005476
2005	1.03	1.46075855	1.41115641
2004	1.028	1.50165979	1.45066879
2003	1.017	1.52718801	1.47533016
2002	1.017	1.55315021	1.50041077
2001	1.03	1.59974471	1.54542309
2000	1.011	1.6173419	1.56242275
1999	1.03	1.66586216	1.60929543
1998	1.03	1.71583803	1.65757429
1997	1.021	1.75187063	1.69238335
1996	1.03	1.80442674	1.74315485
1995	1.022	1.84412413	1.78150426
1994	1.018	1.87731837	1.81357133
1993	1.03	1.93363792	1.86797847
1992	1.03	1.99164706	1.92401783
1991	1.03	2.05139647	1.98173836
1990	1.03	2.11293836	2.04119051
1989	1.03	2.17632651	2.10242623

ANNEX 3 – CPI and RPI increases (based on September index)

Year	CPI (September Based)	RPI (September Based)
2020	1.017	1.024
2019	1.024	1.033
2018	1.03	1.039
2017	1.01	1.02
2016	0.999	1.008
2015	1.012	1.023
2014	1.027	1.032
2013	1.022	1.026
2012	1.052	1.056
2011	1.031	1.046
2010	1.011	0.986
2009	1.052	1.05
2008	1.018	1.039
2007	1.024	1.036
2006	1.025	1.027
2005	1.011	1.031
2004	1.014	1.028
2003	1.01	1.017
2002	1.013	1.017
2001	1.01	1.033
2000	1.012	1.011
1999	1.014	1.032
1998	1.018	1.036
1997	1.023	1.021
1996	1.03	1.039
1995	1.015	1.022
1994	1.031	1.018
1993	1.03	1.036
1992	1.071	1.041
1991	1.081	1.109
1990	1.052	1.076
1989	#N/A	1.059
1988	#N/A	1.042
1987	#N/A	1.03

