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INTERNSHIP REPORT

EFFECTS OF TRANSFERS ON LIABILITIES OF PENSION SCHEMES

LORENZO SERLENGA

SUPERVISION:

ELIZABETH METCALFE
ONOFRE SIMÕES

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The most incomprehensible thing about the world is that it is comprehensible.
Albert Einstein

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Abstract

In the last years the regulations for pension plans membership became more flexible and most members have now the possibility to move from a scheme to another, according to their personal and financial needs. This means members are able to move their accumulated pots through a transfer, and this usually happens from a Defined Benefit (DB) to a Defined Contribution (DC) scheme. The option to transfer is justified because DC schemes are characterized by more freedom regarding the way benefits are collected and sometimes more control on the way the money is invested - although the member will take on the investment risk, the longevity risk and the income management risk. Transfers are a complex procedure from the actuarial point of view: trustees need to calculate the lump sum to be provided to the member leaving the scheme, a task performed with the assistance of actuaries, who are asked to set the economic and demographic assumptions required for the calculation. This work is a result of an internship at the Lisbon Service Center of Willis Tower Watson, where I have been involved in the UK pension fund valuation process, with the objective of projecting the future liability of schemes. Legislation imposes that UK firms must perform valuations of the schemes at least every three years, given the importance, both for members and clients, of knowing their funding position and financial situation. Transfers are expected to increase the liability in the short run, because of the lump sums that need to be paid. Once the liability projection is obtained, it is possible to give a feedback on how schemes should manage investments on assets.

KEYWORDS: Pension Schemes, Transfers, Defined Contribution, Defined Benefit, Assets and Liabilities, UK.

Resumo

Nos últimos anos, as regras de adesão aos planos de pensões no Reino Unido tornaram-se mais flexíveis e a maioria dos membros passou a ter a possibilidade de mudar de um plano para outro, de acordo com as suas necessidades pessoais e financeiras. Isto significa que um dado membro, se assim o desejar, pode transferir o valor acumulado das contribuições feitas em seu favor para um outro fundo. Normalmente a transferência é de um plano de Benefício Definido (BD) para um plano de Contribuição Definida (CD). A opção de transferir é justificada sobretudo pelo facto de os planos CD serem mais flexíveis na forma como os benefícios são recebidos e, às vezes, permitirem um maior controlo do membro sobre a forma como o dinheiro é investido - embora com a contrapartida de que passará a assumir o risco do investimento, o risco de longevidade e o risco de gestão do benefício. As transferências são um procedimento complexo do ponto de vista atuarial: os administradores precisam de calcular o montante que deve ser entregue ao membro que sai, uma tarefa realizada com a assistência do atuário do plano, que tem que definir os pressupostos económicos e demográficos necessários para o cálculo. Este trabalho resulta de um estágio no Lisbon Service Centre da Willis Tower Watson, onde estive envolvido no processo de avaliação de fundos de pensões do Reino Unido, com o objetivo de projetar as responsabilidades futuras dos planos. A legislação impõe que as empresas do Reino Unido realizem avaliações, pelo menos, a cada três anos, dada a importância, tanto para os membros como para as empresas, de conhecer o respetivo nível de financiamento e a situação financeira, em geral. No que diz respeito às transferências, espera-se que estas aumentem o passivo, no curto prazo, devido aos elevados pagamentos que envolvem. Mas, uma vez obtida a projeção destes montantes, é possível planear em conformidade a forma como devem ser feitos os investimentos em ativos.

PALAVRAS-CHAVE: Planos de Pensões, Transferências, Contribuição Definida, Benefício Definido, Ativos e Passivos, Reino Unido.

Chapter 1

Introduction

The need for security has always been one of the main concerns for people, and this leads to an increasing role of savings, even because having a stable income is no longer a guaranteed achievement. This is the reason why the pension scheme system has been in place for decades and worldwide, and a good functioning of it is necessary. Pension funds are able to provide a stream of payments for members when they retire, in exchange of contributions deposited during the working time.

In the real world we are observing a change in behavior and choices in pension schemes. In particular, during the last years a large number of members are moving from a Defined Benefit to a Defined Contribution pension scheme.

In the UK, the regulations for membership became more flexible in the last years and most of the members have now the possibility to move from a scheme to another, according to the variation of personal or family needs. There are also some safeguards in place, to help ensure that members and benefits are protected. These include getting advice from a regulated adviser before a transfer of benefits. (The Pension Advisory Service, 2020)

The constant uncertainty of this sector, drove the industry to hire specialists, namely actuaries, to advice on benefit plans and consult on the financial ability of schemes to sustain the liabilities. It is crucial for an actuary to value schemes from an ongoing, solvency and PPF perspectives, especially while considering UK pension funds. The challenge may be setting the assumptions, whereby the actuary tends to be more conservative concerning this part of the valuation.

This work was produced as a result of an Internship offered by Willis Towers Watson, at the Lisbon Service Center (LSC), and focused on UK pension plans valuations. The LSC is an excellence center that currently undertakes all UK defined benefit plan valuations for the retirement business, in cooperation with the Consulting Office (Reigate). The valuation service is managed by David Pires. In particular, LSC currently supports the business on:

- actuarial valuations work (including live valuations and conversions): LSC currently undertakes all UK defined benefit plan valuations for the UK Retirement business. Typical projects are Triennial statutory actuarial valuations, Liability calculations for accounting updates, Liability calculations with transfer out decrements;
- individual member calculations: to provide support to UK Retirement

teams to help free up consultant's time for added value work. The team that handle a wide range of calculation types and complexities, like consulting review on standard calculations.

- GMP (Guaranteed Minimum Pension) reconciliation: the goal is to help pension schemes reconciling their membership numbers and GMP figures. The projects go through different data issues like incorrect calculations, clerical errors and inconsistency with dates, earnings and contributions;
- data digitization and pension-construction exercises: area of Data Solutions which convert data from physical supports to digital format, using state-of-the-art software based on artificial intelligence algorithms. Supports GMP reconciliation, retrenching or contingent spouse's pension projects.

The services are delivered through a dedicated team that is allocated to UK Retirement, UK Risk Solutions and Western Europe Retirement.

As already referred, this work is focused on UK pension plans valuations. The valuation project is divided into a series of different work stages. Each work stage contains a number of actions that need to be completed to progress the valuation: data inputs, data checking, assumptions setting and testing, and finally reconciliation of asset and liabilities, through a roll forward approach. Some actions need to be completed by the Consulting Office team and some by the LSC team.

Throughout this report we will determine the funding level, by altering assumptions/contributions/pension increases/membership status and other factors from previous valuation. The overall aim is for the valuation to progress as smoothly as possible with the Consulting Office and LSC working as a single team. Good communication between team members is essential in achieving this aim. The tools used for the purposes of this valuation are WTW specific, and only after a training period of about one month, the intern is able to perform real tasks and become familiar with the software and the process. Is through Excel templates and EUVal that LSC is able to perform all the stages of the process.

During the internship I was able to learn how to manage with different stages of the process and thanks to the help of the team, to build my own knowledge, focusing on my objective for the five-month duration.

Main motivations and goals of this work are investigating the reasons that can lead a member to decide to take a transfer, the procedures in order to obtain it, and mainly the management of transfers from an asset/liability point of view for the UK pension system.

Why is this so important? Moving from a DB to a DC practically means the member prefers having more flexibility regarding the invested money, losing at the same time the right of an income certain at pensionable age. When a member decides to leave a DB pension scheme, a lump sum is usually paid, reflecting future liabilities due. For firms is crucial obtaining information about member behavior and how this is linked to world circumstances, because they will have to satisfy (cover) the clients' rights. Obtaining forecasts in this sense is important, in order to manage present and future liabilities. We will describe more precisely along this work the different types of schemes and how can clients relate with them.

This report is divided in five chapters. In the next one (Chapter 2) we give

an introduction about UK pension schemes, as a good understanding of them is indeed important to understand the process behind decisions taken by firms. We will also show how the WTW software works, in order to make it clear how the decisions are made and how results are obtained.

Chapter 3 is about transfers, and is the core for the topic investigated in this work. As stated before, is important to comprehend why people decide to change from a scheme to another and the different ways they can approach the decision-making process. Also, regulations have changed quite often in the last years, and this must be taken into consideration.

In Chapter 4 the effect of transfers is analyzed with a real-world case study. We will use data from a client we have been working for and, without disclosure about any identity or names of the firm, we explain how LSC dealt with it, and how firms should deal with it. Two methods will be introduced in order to obtain a liability projection and deduct the funding position of the scheme in a long-time horizon and based on three possible scenarios. The last chapter is the conclusion of the project.

Chapter 2

UK pension funds characterization

Pensions in the United Kingdom, whereby United Kingdom residents have part of their wages deducted to save for retirement, can be categorized into three major divisions (with seven sub-divisions), covering both defined benefit and defined contribution schemes:

- State pensions;
- Occupational pensions;
- Individual/personal pension;

In this chapter the specifics of each type of pension will be described, highlighting their structure and how (and under which conditions) the benefits are provided. We will then explain how a pension fund is valuated, illustrating the process followed by the LSC. The modern State pension started in 1908 with the first Pension Act. The objective was the accomplishment of a system of social security through this and other reforms. The first pension was paying 5 shillings a week for people aged more than 70 and with an annual income not exceeding £31. Since that time, a long way has come. Nowadays employees can find arrangements with their employers, who establish Occupational pension schemes to provide benefit to the workers. These are regulated by several Acts: the Pension Schemes Act 1993[1], the Pensions Act 1995[2] and the Pensions Act 2008[3]. With the individual/personal pension, any individual can find an arrangement with an external provider, making contributions which are invested during the individual working life and are used to purchase an income when in retirement. Within this type of pension there are the self-invested personal pension plans, where the member can decide autonomously how to invest the contributions made.

2.1 The State Pension

The basic state pension, then known as the "Old Age Pension", was introduced in January 1909 under the principle of preventing the poverty in old age. The first

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[1] www.legislation.gov.uk/1993
[2] www.legislation.gov.uk/1995
[3] www.legislation.gov.uk/2008

amount was 5 shilling a week and was payable to men and women over 65 and 60, respectively. Families were subject to a means test, in order to determine if they were eligible for this 'assistance', based upon whether the individual or family had the possibility to survive without this type of help. The retirement age is going to increase through the years and it will reach 68 (for women) not later than 2046 according to the forecasts. People born before the Fifties are entitled to the basic State pension, with a maximum payable amount of £134.25 per week in the case of a total of 30 qualifying years. Men born after 1951 and women born after 1953 are now entitled to the new State pension, with a maximum of £175.20 payable per week, in the case of 35 qualifying years.

2.2 Occupational Pension

Occupational pensions schemes have been designed in order to provide people a pension while in retirement, in addition to the State pension previously exposed. These kind of pension plans are totally managed by employers, who take decisions on behalf of employers, and are regulated by the Pension Scheme Act 1993, which has been modified and updated along the years. If both the employer and the employee make contributions to the fund, it is considered as contributory; if only the employer contributes, it is non-contributory. There may be different types of plan, depending on how the contributions are used: if contributions are invested over time and accumulated they are called funded; or if the revenue from current contributions is directly used to pay for current retirement benefits they are called non-funded, Finally, they can be insured, in the case the investment is on the purchase of an insurance policy, or self-administered, in case beneficiaries manage the fund investments. All of them aim to provide pensioners with an income in retirement but they might work in different ways and are sometimes referred to by different names. There are many different types of occupational pensions today, which broadly fall under three main categories:

- defined contribution schemes - based on how much money has been paid into the pension pot;
- defined benefit schemes (final salary or career average) – based on the employee's salary and how long he/she has worked for the employer;
- cash balance plans;

2.2.1 Defined Contribution Pension Schemes

A Defined Contribution main characteristic is that the contribution stream is agreed between parts from the beginning of the contract. The pension accumulated is also known as 'money purchased' pension, as the member is 'buying' it. The member can find an arrangement with their employers (workplace pensions) or with an external entity. The contributions made by the member are then invested in a fund and managed by the pension provider, who also is the one choosing where to invest in a set of different options. The amount obtained at retirement is not guaranteed and fixed, as it varies depending on the amount of time the contributions have been invested, and mostly on performance of the investments. When the time of taking the income comes, the pot accumulated can

then go up or down. With defined contribution pensions the employee decides how to take the money out. There are different types of defined contribution pension, these include:

- Executive pension plans: are pensions set up by employers for executives or key employees of the company. Both employees and employer can make contributions. It's a tax efficient way to set aside money for retirement because it is possible to claim tax relief;[4]
- Group personal pension: is a pension set up by the employer. It's a collection of individual pension plans. The employer will be automatically enrolled depending on age and salary, and employees will contribute as well;
- Master trust pension: is a pension set up by Master Trust which may be joined by more than one employer. It differs from the traditional Operation Pension schemes which provide a workplace pension for a group of employers that are part of the same group of companies. Each one of them has the possibility to control and manage its own division, taking advantage of low costs and easiness of governance. There is one legal trust and therefore one trustee board. Examples are: People's Pension, Smart Pension, NEST and NOW;
- SIPP (Self Invested Personal Pension): this type of DC plan is designed for people who want to manage their own fund by changing where the contributions is invested. In order to do this the individual will need to have experience in investing. Other than the power to change the investments, SIPP expect the member to deal with any issue that may arise;
- SSAS (Small Self-Administered Schemes): members of the scheme are usually directors of a company, and it usually do not include more than 11 members. The participant sometimes owns a notional share of the SSAS funds including non-insured assets, and possibly insured money held in an investment plan;
- Stakeholder pension: these schemes are designed to provide easiness of access to everyone, and member will find flexible ways to build the retirement benefit. For these reasons they are suited for people with a low income or self-employees. They are arranged by a contract between an individual and the pension provider and must follow well defined government conditions.

2.2.2 Defined Benefit Pension Schemes

Defined benefit pension schemes provide retirement benefits that are based on salary, years of work for the employer, number of years as a member of the scheme and a calculation formula under the rules of the scheme. Such schemes guarantee a certain amount each year post-retirement.

Defined benefit pensions are almost always workplace pensions arranged by the employer. Contributions are made based on the individual's earnings. Each pension scheme defines what is meant by 'earnings'. This may not be the same amount that is shown on the pay slip. Earnings for pension purposes (or pensionable earnings) may not include payments received such as overtime, commission,

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[4]A guide to executive pensions.pdf

bonuses or other benefits. Examples of defined benefit pension schemes include final salary schemes and career average revalued earnings (CARE) schemes. They may also be based only on a proportion of wages or salary. Summing up, the main difference between them is the one between the formulas below, where (2.1) refers to the Final Salary Rule and (2.2) to the CARE rule.

$$P = r \times n \times PS \tag{2.1}$$

where $\boldsymbol{P}$ is the annual pension, $\boldsymbol{r}$ is the accrual rate, $\boldsymbol{n}$ is the number of years of service and $\boldsymbol{PS}$ is the final pensionable salary. The accrual rate is the proportion of earnings for each year of service;

$$P = r \sum_{t=1}^{n} PS_t f_t \tag{2.2}$$

where $\boldsymbol{P}$ and $\boldsymbol{r}$ have the same meaning as before, $\boldsymbol{PS}$ is the pensionable salary in year t and f_t is the revaluation factor between year t and the retirement age, $t = 1, ..., n$. The Defined Benefit schemes are typically administered by specialized trustees or, in case of government workers, by the government itself. Often, the trustees can be members of the scheme, employees of the sponsoring employer, or both. Trustees hold the obligation to ensure that the scheme has enough means in accordance with the terms of the trust and have the legal power of managing the schemes, mainly the assets. Nowadays many companies are replacing DB plans with DC plans, due to both reduced expenses of the latter and the long-term obligations associated with the DB schemes. As the workforce has aged, the costs of funding a DB plan have been increasing because the level of accrued benefits is higher and the post-retirement period has lengthened, due to early retirements and increased longevity. It may be difficult for firms to adjust compensation in response to shocks to forecasted values of longevity, benefit costs, or asset returns. The recent acceleration of the trend towards DC plans appears to be linked to a confluence of factors, namely: persistent pension under-funding, due to a decline in long-term interest rates; the move to more market based accounting practices, increasing the regulatory burden and uncertainty; the recognition of the effects of increased longevity on plan costs. All this has prompted plan sponsors to improve their awareness of the financial risks in DB plans. It is also linked to regulatory and accounting reform, which is making these risks more transparent. Since DC contributions can be fixed as a predictable share of payroll, migrating to a DC plan offers employers a mean to reduce the volatility in earnings and, accordingly, in the balance sheet, at least over the long term. (Broadbent et. all, 2006) DB schemes can be in different scheme status. They might be open, in the sense that new members can join. It's not rare to find schemes closed to new members. Some schemes may also be closed to future accruals where members can no longer accrue new years of service. When a scheme is closing for any reason, it is commonly said it is winding up.

2.3 Individual/Personal Pension

A personal pension scheme is designed to provide a retirement benefit as the prime purpose, but it may also provide death or disability benefits. This plan

has some tax advantages, as part of the fund (usually 25%) may be taken as a tax-free lump sum at retirement. Personal pension schemes became available in 1988 (TPAS 2020). Contribution can be made by employers as well as by employees. The member's contributions are invested in funds, which can be chosen from a set of funds. Those are made available by the providers, who also decides the quantity of funds to offer. Through the payment of a fee members are allowed to change the fund in which the contributions are invested. They might want to do that looking for a higher return, achievable with long term investments. At the same time, an investment with higher return usually expect to be a riskier one, being the return more uncertain with the ongoing of time. The benefit the employee will get from a personal pension usually depends on: how much has been paid in; how the fund's investments have performed; the decisions (timing and amounts) on taking the money.

Usually members can get the benefit after age 55, or, they can take it earlier in case of bad health conditions. Some plans still hold the old legislation obliging members to take the benefit before age 75.

2.4 Valuation of a UK Pension Fund

The traditional approach to valuate pension funds in the United Kingdom is to use an off-market approach to valuing assets and liabilities. The traditional valuation is primarily concerned with setting a contribution rate (Head et al. 2000). This is part of a procedure to control the pace at which a fund is built up to meet the liabilities and involves many assumptions. It can be considered as an algorithm for setting the contribution rate, but with the assumptions used determining the pace of funding. It is conventional to work with present values rather that rolling all payments up to a terminal date. The use of a constant interest rate for all time periods is not essential for accumulation or discounting, but, conveniently, does allow the use of standard actuarial functions to switch back and forth (Head et. al, 2000). Pension valuations are based on 4 different subsets of objectives: commercial transactions; funding; accounting and regulatory.

Commercial transaction: a transaction is to be considered as the payment of some cash in exchange of future benefits. It may manifest as individual or bulk payments, pension transfers or any deal between an employer and his/her employee.

Funding: A client may be interested on the amount of the contributions and how the investment may grow in the future if they join a scheme. In particular he/she may want to be informed on how the asset are performing on covering liabilities and how surplus would be distributed to members or employers participating in the scheme.

Accounting: the employers who are sponsors of pension scheme need to know pension expenses for their accounts. This might require not trivial calculations and evaluations, because of the variety of principles and legislations in UK and at an international level. An example of standard requirement is the Minimum Funding Requirement, fundamental for the well-being of the clients of the fund.

2.4.1 Valuing Liabilities

As stated in the previous section, some assumptions are necessary in order to define a contribution rate. A very important assumptions is the one regarding the return on assets, because along the valuation the liabilities are discounted back to present time or to a reference date using this assumed rate as a starting point. If the study behind is consistent and the assumptions are correct, the company could put in a plan the funds needed to cover present and future liabilities, even considering future salary increases of the members to be remunerated. In the following paragraph some basic concepts are explained in order to understand clearly how to value liabilities. Actuarial accrued liability (AL): it's the amount that the scheme needs to set aside in order to cover future benefits. It may also be called Project Benefit Obligation (PBO). Exist a variety of methods to calculate it, and most of them make use only of the past service. Sometimes the methods include the consideration of expected future salary increase because some pension plans are arranged in a way that the pension benefit is based on the final salary. The actuary should provide to the sponsor of the plan the forecast of the future benefit due to members based on expected salary increase. Normal Cost (NC): the portion of the PVFB that is attributed to the current service, i.e., roughly is how much to pay in each year to fund benefits. Actuaries calculate the expected future pension payments for each participant in the plan using the company's participant data and plan provisions. These future benefit payments consider the individual's compensation and service history and probability models for mortality, disability, withdrawal and retirement. Each future payment is discounted from the date of payment to the valuation date using the actuarial assumptions. Actuaries call this amount the present value of future benefits (PVFB) and it represents the present value of all benefits expected to be paid from the plan to current participants. (Domingos, 2019) If we assume a level annual benefit of B, payable from the Normal Retirement Age (NRA) till the death of the member, Figure 2.1 displays the way it works. The Valuation Age is VA and the Entry Age to the scheme is EA.
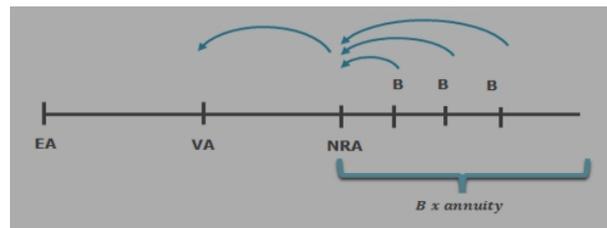
Figure 2.1: Future benefit of a member currently age VA
Source: Domingos 2019

We start by computing the present value of the future benefits at retirement age,

$$PVFB_{NRA} = B \times a_{NRA} \qquad (2.3)$$

where a_{NRA} is the present value of an immediate whole life annuity payable to a life aged NRA. Very often the annuity is a deferred annuity at the valuation age, the deferred period being equal to NRA-VA. It is then necessary to actuarially discount the amount in (2.3) with interest at a given rate i, to calculate the

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discount factor v_i^{NRA-VA}, and with a given survival model, to calculate the probability of the member surviving the deferred period, $_{NRA-VA}p_{VA}$. The result is

$$PVFB_{VA} = PVFB_{NRA} \times v_i^{NRA-VA} \times {}_{NRA-VA}p_{VA} \qquad (2.4)$$

To guarantee coherent results, regardless of the reference date for discounting values, it is convenient that the rate of interest for past amounts is equal to the average rate of interest at which existing assets and future contributions are assumed to be invested (none of them enter explicitly in equations (2.3) and (2.4)). The long-term rate of interest is, therefore, an amalgam of current investments returns available in the market and future unknown investments returns. Again, one crucial point is that actuaries are required to make an assumption about future long-term investments returns. This process is developed by observing stable historic differences between investment returns and price inflation. The Treasury considers that the discount rate should be, in general, in line with the new SCAPE methodology discount rate, of 2.4% above CPI, the Consumer Prices Index. SCAPE is the acronym for "Superannuation Contributions Adjusted for Past Experience"[5] . In the particular case of a guaranteed minimum pension, of which part is attributable to earning factors in any of the tax year 1988-1989, and following, the discount rate is 2.6% per annum, net of benefit increases. When it is a non-increasing benefit, the discount rate is 4.448% per annum. In the next paragraphs we will describe the valuation process at Willis Towers Watson.

2.4.2 Valuation process of a UK pension fund at Willis Towers Watson

The process has three main stages:
1. Within the planning call, the LSC agrees with the client on the types of data that will be provided, deadlines of the various steps of the process and the strategy adopted to carry the valuation;
2. Before starting with the implementation of the methods, assumptions must be made, basing on the characteristics of the scheme and of the membership, and on the funding position at last valuation;
3. The practical process, when actuaries compute the liability projection using specific WTW software. Feedbacks and any issue that may arise along the process are constantly communicated to the client in order to optimize results and timing;

Stages 2 and 3 are explained in detail in the following paragraphs.
Stage 2

First, it is necessary to make clear that an actuarial liability funding method is based on the budgeting scheme (or the payment plan) under which the benefits will be financed. It is the controlling factor in determining how much of the eventual cost has to be paid at any particular time. The choice of the financing method does not interfere with the real cost of the plan, but with the way it is financed. There are several financing methods that originate enough funds to cover liabilities. The most common ones are in Figure 2.2

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[5]assets.publishing.service.gov.uk/Consultation on the discount rate used to set unfunded public services
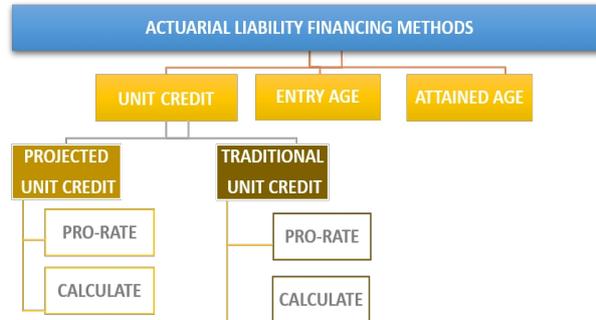
Figure 2.2: Financing methods of DB pension schemes
Source: Dentinho and Rodrigues, 2019

Stage3

As to the setting of assumptions, also in Stage 2, they will be discussed in Section 2.5. Stage 3 consists of four steps.

1. *Analyzing pension data*: In order to value the liabilities of a Scheme, the LSC need to know who's in the Scheme, how old they are, what pension they have accrued, service dates, salaries, and many other relevant information. For valuations, the LSC needs to get hold of this data from the Scheme administrators (the people in charge of actually administrating the Scheme day-to-day). So two months after the data request the administrators will send out the specific data required to value each member's pension liability. This data is then checked to make sure it's reasonable to use in the valuation looking if there are any data items needed for the calculations that are missing. Data is fundamental to perform all sorts of calculations;

2. *Performing a run on last valuation's assumptions*: This step consists in calculating the scheme liabilities using the assumptions from last valuation, applied to the new data provided. This will help to discuss if the forecasts and assumptions used in the last valuation meet reality and also to understand if and why the funding position has changed;

3. *Performing a run on the new assumptions*: After the previous steps, the analyst will use the current assumptions in order to value benefits. The assumptions reflect the current market conditions and demographic experience, including discount rates, pension increases, salary increases, mortality, ill-health retirement and many more. The liability projections based on different scenarios are sent back to the scheme, together with results from last valuation;

4. *Reporting workstage*: At this step, possible assumptions with client (Trustees) and present initial results based on these possible assumptions are discussed with the client towards a presentation prepared for the meeting.

The Trustees and Company usually have to agree a basis for funding as well as the final results from a list of different valuations. Other required professional and statutory reports need to be provided (Solvency results, risks), even explaining the limitation of the valuation and send the final report to the Pensions Regulator.

2.5 Assumptions and WTW Software

At the time the actuarial valuation is conducted, the actuary needs to choose the assumptions that are going to be used in order to define the financial stability of the scheme. With this process the actuary will investigate the future liabilities of the scheme, a quantity depending on the assumptions picked by the actuary. In this chapter we will expose a set of assumptions used during the actuarial valuations at the LSC, namely economic and demographic assumptions, including discount rates, inflation, mortality tables, proportion married, commutation, transfer out. The choice of the assumption will vary when dealing with different schemes, because each of them has their own characteristics and singularities. The membership, the structure of the scheme and other fundamental factors will indeed lead the actuary to choose scheme specific assumptions. Some factors have a bigger impact on the calculations, so attention dedicated to them will be higher. If the scheme has not undergone any substantial modification from the date of last valuation, the actuary can use the knowledge on the past valuation to obtain some help when deciding which assumptions should be selected. He/she must always be very careful within this process, as past studies may not always be a good indicator for future experience.
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2.5.1 Discount Rates

Within the valuation of a scheme, there are some factors that will influence the choice of the discount rates. The actuary must be prudent while choosing the rate, as those factors are scheme specific and can not always be compared to those from other schemes or past valuations. Some of the major concern are:
- The yield of the assets held by the scheme;
- The return on investments;
- The yields on government bonds.

The scheme is funded with earning coming mainly from these three sources. They have different timing and maturity so recently schemes have been using a structure of rates able to capture the full shape of the interest rate curve, so that different future benefit payments are discounted with the relative rate. As the Gilt yields replicate very closely the assets for pension liabilities, those are taken as a starting point and a margin is added to include expected bad performance of some eventual assets that may not perform well.

2.5.2 Economic and demographic assumptions

Pension schemes are linked to an inflation factor such as pension increases, revaluation in deferment or salary increases. Some benefits increase in line with Retail Prices Index (RPI), and other are in line with the Consumer Prices Index (CPI). For RPI inflation, the market-based measure of future RPI can be obtained through calculating the difference between nominal yields on fixed-interest gilts and real yields on RPI linked gilts. In the case of CPI inflation, the approach to setting a CPI assumption is to make a deduction to the RPI assumption, reflecting methodological differences between the two indices. The inputs come directly from the administrator of the scheme through a Run Request Form, an excel template in which is exposed the way and the assumption to make for each specific valuation.

Each category of membership in a pension plan is linked to an inflation factor: pensioners to the pension increases, deferreds to the revaluation in deferment, and actives to salary increases. Those variations are faced using whether a CPI (Consumer Price Index) or an RPI (Retail Price Index) approach. As state before, while dragging estimations on future outcomes, the actuary should apply a professional judgment based on past experience and future forecasted developments of the factors taken into account. The selection of the assumptions will then reflect the characteristic of the plan under analysis, and each contingency and eventual situation should be assessed identifying two or more reasonable assumptions. When it comes to demographic assumptions, the actuary needs to consider the materiality of each choice and the consequences that a variation might have on future calculations. The future experience might deviate from the chosen assumption leading to differences between the liability projection and the reality of facts. The assumptions are chosen from an available set by the actuary, who should be prudent and should consider measurement-specific factors, examples are as follows:

a. the purpose and nature of the measurement. For example, a cash flow projection may require more refined assumptions than a liability measure;

b. any features of the plan design, or change in the plan design, that may influence the assumption. For example, the introduction of an early retirement subsidy could influence the plan's incidence of retirement; under these circumstances, in order to measure the incremental cost associated with this change, the retirement assumption for the proposed plan provision may differ from the retirement assumption for the current provision;

c. relevant factors known to the actuary that may affect future experience, such as the economic conditions of the area or industry, availability of alternative employment, or the human resources policy or practices of the employer. (Ana Maria, 2017).

The most important demographic assumptions are explained next.
Mortality base tables
The choice of the mortality table includes the selection of a base table expressing the current mortality, and a table counting for future improvements in life expectancy of the population. As stated before the actuary must follow

the principle of prudence, taking into account the characteristics of the membership and the expected risks coming from future changes. UK schemes make use of tables produced by the Continuous Mortality Investigation (CMI), which usually produce different table basing them on gender, health status and members status (pensioners or non-pensioners). Sometimes an additional mortality analysis is carried out in the interest of the sponsor of the scheme, during the valuation process. It is done depending on the size of the scheme and, basing on postcodes of the members' residence, it gives an even more actual and updated information on actual mortality experience. Postcodes are provided in most of the valuations conducted at the LSC.

Proportion married

These assumptions made by the actuaries is important because when the member dies, the spouse is usually eligible to receive the pension. In most schemes the spouses will get 50% of the original pension, and the proportion married is between 80% and 90%.

Commutation

Commutation comes in place when a member takes the right to withdraw a lump sum when he/she retire. Usually members are allowed to take up to 25% of the pension without paying any tax. This will decrease the long-term liabilities of the scheme and eliminate the longevity risk for the commuted pension, in exchange of an immediate payment due to the member.

Transfer out

In the recent times pension schemes faced an increasing number of transfers from a Defined Benefit to a Defined Contribution plan, due to a bigger management flexibility of the latter. A transfer out will decrease the liability of the scheme as well as the contribution made. Similarly to the commutation, the longevity risk is eliminated (here for the whole accumulated pot). Different situations and effects that may arise from transfers are deeply analyzed in Chapter 3 and Chapter 4.

Chapter 3

Transfers

Sometimes the members of a scheme consider transferring into a new workplace pension scheme, or into a personal pension, a stakeholder pension, or even a self-invested personal pension (SIPP). In this chapter we will analyze the different situations that may arise when someone wishes to move from a pension scheme to another, or to move out definitively from a scheme. A member will be able to transfer the pension if he/she is in a private sector defined benefit scheme, or a funded public sector pension scheme (such as the local government pension). There are certain safeguards in place for these schemes. If the member is in what is called an 'unfunded' public sector scheme, he/she will not be able to transfer. Examples of unfunded public sector pension schemes in the UK are the Teachers Scheme, the NHS (National Health Service) Workers Scheme, the Firefighters Scheme and the Armed Forces Scheme.

Transfers work as described next. If a member decides to transfer out of his/her workplace defined benefit pension scheme, the trustees who run the scheme convert the benefit built up into a cash sum. This is called a 'transfer value' (also known as a 'cash-equivalent transfer value' or 'CETV'). Not all employer pension schemes, personal pensions or SIPPs accept transfers, so the member must check this availability. Sometimes it may happen that the employer offers a financial incentive to transfer out of a DB pension scheme. This might be a cash payment on top of the transfer or an enhancement to the calculated transfer value of the benefit in the scheme ('enhanced transfer value'). This may not always be as attractive as it looks. A transfer incentive as cash may involve the payment of Income Tax and National Insurance. Along this chapter many aspects of the transfers will be analyzed, including the motivations that can lead members to transfer the pension pots, highlighting possible advantages and disadvantages, and some basic regulations. Those are important, as it is not possible to do anything without the support of a legal framework. Another fundamental part of the transfer process is the calculation of the CETV, including all the assumptions that must be taken into consideration. The discount rate plays a central role: it is chosen by the company and need to follow some regulations. This topic will be investigated deeply because, as we will see in Chapter 4, the CETV is a key element when calculating the effects on liability of the pension fund resulting from transfers. Some real-world cases will be presented too, to help the reader to understand the impact that a huge transfer may have on the schemes.

3.1   Motivation for transfer

Different members mean different personal needs, and so different reasons to transfer to another pension scheme. There are many reasons why a member would like to transfer and in this section we will try to expose and analyze most of them. The motivations may vary from individual to individual, each one will look for the most suitable option. One of the reasons may be the fear people feel about the survival of the company where they have built up the bulk of their retirement benefits, in which case the funds are reallocated to another scheme. This is especially true in this period of crisis, where uncertainty on future income is a main concern for individuals, although still exist some who prefer to take a lump sum instead of receiving the income ensured by a Defined Benefit plan. Other reason to transfer is the will to obtain a higher pension benefit or a decrease in the fees. For example, transferring to a Defined Contribution plan may provide advantages regarding the Life Time Allowance. The LTA is a limit on the amount of pension benefit that can be drawn and paid without an extra charge.[1][2] [3]. Within a DC scheme, if a member dies before reaching 75, the money in the pension below the LTA can be passed to legal heirs without taxes. Moreover, if a member is receiving pensions from more than one employer, he/she may find useful to combine those in a single fund. With this operation the worker will simplify the management of the fund. If a worker is going to live in another country (overseas), transferring the pot to a fund based in the new State would be advisable, for comfort reasons and again in order to obtain easiness of management. A flood of DB schemes, meanwhile, are moving to close to new members and future accruals as BMW did in 2017[4] .

3.2   Types of transfers

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3.2.1   Transfer from a DB Scheme to a DC Scheme

Defined Benefit schemes allow the participant to have a secure pension income after retirement, and a transfer to a DC scheme will cause a loss of this advantage. For this reason, this type of transfer is not always advisable, and a partial transfer can be a good meeting point, providing the flexibility typical of a DC scheme and the secure benefit of the DB one. However sometimes the loss of safeguarded benefit in exchange of more decisional freedom may be advantageous. The following paragraphs highlight some of the advantages and disadvantages of transferring from a DB scheme to a DC scheme.

- A first possible advantage of transferring is the possibility of obtaining incentives from the scheme. Sometime the trustees do this to manage the fund, in order to reduce future liabilities;
- *Flexibility*: Regarding flexibility, a few details are relevant. In a DC plan, members are allowed to select the level of income they draw down from

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[1] Pension tax manual.1
[2] Pension tax manual.2
[3] www.pensionsadvisoryservice.org.uk/pension-and-tax
[4] www.ftadviser.com bmw plans to close final salary scheme to future accrual

their pension. They may do this in order to meet personal liquidity needs or to manage taxes. Under a DB pension scheme this is not an option and the scheme decide the amount to be paid, without the option to vary. Moreover, flexibility is related with the timing of the benefits to be provided, in the sense that within a DC plan the participant can chose an early retirement (with a consequent reduction of the pension benefit), but DB schemes usually have a fixed retirement age without any possibility of early retirement;

- Transferring to a Defined Contribution pension will give the clients the chance of getting a higher life annuity rate. This happens because the DC scheme is affected by the lifestyle of the member and his/her health. These may have impact on the longevity and therefore have impact on the annuity rates. A Defined Benefit plan will not consider the health/lifestyle issue of the member, who would be eventually advantaged;

- The death benefit is another key point to value when deciding to transfer. Defined Benefit schemes do not allow members to nominate who they want their benefit to be paid. In general, the scheme will pay it to the surviving spouse and children and stepchildren below age 23. In a DC scheme the members can choose their spouse, children or even grandchildren to receive their death benefit. Also, the tax treatment of the death benefit will be different. If death occurs after age 75, the income benefits from a DB schemes are taxable, and within this scheme the tax will be higher than in the DC, because of lack of control attached to DB plans. Conversely the income benefit from DC schemes will not be taxed, as well as the lump sum death benefit from both types of scheme.

Disadvantages include:
- The members will have to self-manage their withdrawal options, deciding how to invest the money and if they have not enough expertise this might require the help of an advisor. This type of responsibility may be costly;
- The risks of transferring to a DC scheme are not negligible: the member will take on the longevity risk, investment risk, income management risk;
- The income at retirement may be less then within the Defined Benefit plan, because the pension pot may fall in value (as well as rise). An even worse case scenario is the member may run out of money in the lifetime;
- Taking a transfer from a DB scheme will cause the loss of the benefit given by the Pension Protection Fund (PPF). This consists in an ongoing protection, which comes in place in case of qualifying insolvency of the employer, who may not be able to pay the liabilities due to members. This is a feature of the Defined Benefit plans only;
- When a member leaves the scheme, he/she will lose any employer contribution to the pension and any eventual incentives or discounts provided from the DB scheme. Other benefits, like concession for death in service or membership, will also be lost.

In conclusion, if a member transfers from a DB scheme to a DC scheme, both the member and dependents will lose the guaranteed lifetime income from the DB scheme and the protections in respect of inflation offered. If the indi-

vidual changes mind about transferring, he/she has around one month to cancel the request, but the ceding pension scheme may refuse to take the money back. The Financial Conduct Authority (FCA)[5] and The Pensions Regulator (TPR)[6] believe that keeping the DB pension and advantages will be the best choice for members.

3.2.2   Registered and non-registered pension schemes

A transfer from one registered pension scheme to another registered pension scheme is known as a recognized transfer. It is a legal requirement for all work-based pension schemes to be registered with HM Revenue and Customs (UK's tax, payments and customs authority), and have more than one member, to also register with The Pensions Regulator. When the fund is transferred no tax relief is applicable. Usually adjustments are made to determine whether there is an increase in pension saving, in the receiving arrangement, and to take into account the transfer payment. A registered pension scheme can receive money from a non-registered one only in some particular cases, for example if the latter is financed by an employer or if it is an overseas pension scheme. Those kinds of transfers are not to be considered as contributions so the transfer value is not free of tax and is not counted as a money purchase arrangement[7]. The transfer value is not counted for a money purchase arrangement as it is not a contribution. The laws linked to overseas pension schemes are not trivial. In case someone wants to transfer the accumulated pot to a scheme based in another country, this need to be a Qualifying Recognized Overseas Pension Scheme (QROPS). It must therefore meet certain requirements set by Her Majesty's Revenue and Customs. The member will have to pay taxes according to whether he/she was a UK resident, where the QROPS is based and when it is taken. In some situation no tax payments are needed, for example if the transfer took place before 9 March 2017 (date when the government legislated to apply taxes), or if the transfer is provided by the employer. As announced at the Spring Budget 2017, the government will apply a 25% tax charge to pension transfers made to QROPS if:

- the member lives outside the UK, Gibraltar or the EEA;
- the member moves to live outside the UK, Gibraltar or the EEA within five years.

There are exceptions, allowing transfers to be made tax free where people have a genuine need to transfer their pensions[8].

3.3   The transfer procedures

In this section we describe the practical steps from the member's point of view (put together the information needed to make the transfer decision) and also from the point of view of the scheme administrator (transfer value calculations and the applicable legislation). In general, the member of a pension scheme

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[5] https://www.fca.org.uk/
[6] https://www.thepensionsregulator.gov.uk/
[7] https://www.gov.uk/hmrc-internal-manuals/pensions-tax-manual/ptm053740
[8] https://www.gov.uk/government/publications/qualifying-recognised-overseas-pension-schemes-charge-on-transfers

must look for financial advice before transferring. Legally, members must have financial advice if the transfer is from:

- defined benefit pension worth more than £30,000;
- defined contribution pension worth more than £30,000 with a guarantee about what will be paid when retirement comes (e.g. a guaranteed annuity rate).

As this is a very important matter, a number of questions need to be asked to both the current provider and to the new provider. The member should gather information about any restrictions, what are the fees that would need to be paid and about any loss of advantages, including the right to take out the money at a certain age and the right to take a tax-free lump sum of more than 25% of the pension. The members should also get to know regulations of the receiving scheme, information on stream of contributions that will have to be made, the eventual set-up fees, and the options and cost for when the member wishes to take the money out. Moreover, if transferring to a Defined Contribution scheme. The new client may need help from a financial adviser to analyze the investment funds and levels of risks offered. Another main concern of the member will be the calculation of the transfer value offered by the scheme from which he/she transfers out. After making the decision, the member needs to complete an application form to request the transfer (or more than one, if transferring more than one pension). Recall that transferring the pension to a non-registered UK pension scheme or to an 'unrecognized' overseas scheme will involve a tax payment on the transfer.

3.3.1 Transfer value calculations

A cash equivalent transfer value (CETV) is the cash value placed on the pension benefits in a certain scheme. In other words, it is the amount the pot of the member would be worth if he/she moved to a different provider. If the transfer value is the same as the pot value, it is unlikely that the member will be charged a fee when transferring[9]. The CETV is calculated using expectation on mortality and benefit that the member would receive remaining in the scheme. It must be calculated on an actuarial basis, taking into account accrued benefits, any options and any discretionary benefits. In summary, the process of converting a Defined Benefit into a CETV is as follows:

1. computation of the member's preserved pension at date of leaving service. This should be based on reasonable annuity rates and it must be calculated on an actuarial basis, taking into account accrued benefits, any options and any discretionary benefits;
2. revaluation of the pension at leaving (normal retirement age), by statutory rules;
3. computation of the cost of buying the revalued pension at normal retirement age. The trustees must, in relation to salary related benefits, consider the financial, economic and demographic assumptions on which the initial cash equivalent is calculated;
4. capital cost at 3. is then 'discounted' back to the present, to provide its current capital value. Deductions can then be made when it comes in payment. Minimum level is stated in the Regulations, but trustees can

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[9]https://www.pensionwise.gov.uk/en/transfer-pension

pay out higher than the minimum level, if the scheme rules allow this.

The trustees must, in relation to salary related benefits, consider the financial, economic and demographic assumptions on which the initial cash equivalent is calculated. A minimum level is stated in the Regulations, but trustees can pay out higher than the minimum level if the scheme rules allow this. Deductions can then be made. The transfer regulations decided that there should not exist much variation in transfer values, however, there is still scope within the regulations to allow a variation which could mean that there is a range of different transfer values for the same set of benefits. Some reasons for variation are:

- discount rate - this is the assumed interest rate used to discount future benefits into current monetary terms. It is often the main assumption in the calculations;
- pension increases - it may be fairly simple to calculate statutory or guaranteed increases, but there may be discretionary increases which have to be factored in;
- underfunding – the trustees may reduce transfer values if the scheme is underfunded, to allow this a "scheme insufficiency report" has to be prepared by an actuary;
- reinstatement – the scheme actuary has to be consistent in the methodology applied to incoming and outgoing transfer.

During the calculations there may be variations due to the assumptions made, namely in the discount rate and in discretionary pension increases (in addiction to statutory and guaranteed increases). In particular, it is important to follow how discount rates are decided by HM Treasury[10], which are applicable to all unfunded public service pension schemes, to the Local Government Pension Schemes for England, Wales, Scotland and Northern Ireland and to the Parliamentary Contributory Pension Fund. The Treasury considers the following objectives to be the most relevant in setting appropriate discount rates for the purpose of calculating CETV[11]:

- compliance with the pensions' legislation;
- stability of the discount rates;
- transparency and simplicity of the approach;
- administrative convenience;

In April 2011 the government published a summary of responses to a consultation focused on «the discount rate used to set contribution rates for the unfunded public service pension schemes through valuations following the Superannuation Contributions Adjusted for Past Experience (SCAPE) methodology – this is known as the SCAPE discount rate.»[12] When the discount rate used for calculating unfunded public service pension contribution rates under SCAPE was reviewed in 2011 and 2016, the primary objectives were to ensure that the future costs of today's pension promises are fairly reflected in current contributions, and to ensure that government has as much confidence as possible that promises made today are being made on a sustainable basis. In October 2018, the Budget confirmed that the SCAPE discount rate is 2.4% above CPI inflation (in line with the Office for Budget Responsibility's latest long-term expectation of Gross Domestic Product growth)[11]. The legislative framework (Occupational

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[10] $https://assets.publishing.service.gov.uk/basis_for_setting_the_discount_rate_for_cetv.pdf$

[11] https://assets.publishing.service.gov.uk/HM_Treasury_guidance_on_discount_public

[12] $https://assets.publishing.service.gov.uk/\_discount\_rate\_summary\_responses.pdf$

Pensions Schemes Regulations 1996[13]) explains that trustees or managers are responsible for setting the economic, financial and demographic assumptions for CETVs, with the aim that, taken as a whole, they should lead to the 'best estimate of the initial cash equivalent'. More formally, under the transfer value regulations[14], a CETV should be the amount required within the pension scheme to make provision for the accrued benefits, options and discretionary benefits which would otherwise be provided. The Treasury continues to believe that the primary objectives of the SCAPE discount rate are consistent with the objectives for the CETV discount rates and the transfer value $regulations^{11}$. All these elements are important to help trustees setting the discount rate. Note that, if the scheme does not have enough funds, the trustees may provide a ''scheme insufficiency report'' with the objective of reducing transfer values. The cash equivalent transfer value is the sum left after eventual administrative costs and additional reductions.

3.4   Regulations

Although the majority of the schemes give the opportunity to transfer out, the acceptance of a transfer-in is not compulsory, unless it is a stakeholder pension, in which case the scheme must accept any transfer from another registered pension scheme. With the Pensions Act 2008 is set up the National Employment Savings Trust (NEST), to facilitate automatic enrolment as part of the government's workplace pension. Initially there were no transfers out allowed, but rules have changed and is now possible to transfer the pot accumulated in this special scheme to other registered schemes or to Qualifying Recognized Overseas Pension. It was initially intended that, from October 2016, pension pots worth less than £10,000 would automatically move with the member when he/she changed job, commonly being called "pot follows member" scheme. In general, it is possible to transfer the pot accumulated during the working service, but there are a few exceptions. Members in the unfunded public sector are not able to transfer out, if not to another unfunded public sector scheme. In occupational schemes, does not exist any statutory right to transfer out, if the member is still contributing to the scheme actively, and if a crystallization of the benefit is in place. The scheme has indeed to check if the benefit arising exceeds the member's Lifetime Allowance, and this is the amount charged to tax payment[15].

Also, if the member is within one year of Normal Retirement Age, the scheme needs to offer non statutory right to transfer, if it is a Defined Benefit plan. Within a DC scheme, conversely there is more freedom and the member will be able to transfer out up to Normal Retirement Age, without any restrictions in terms of time.

If the pension is already in payment, is still possible for the member to transfer to another pension scheme. The ceding scheme will need to provide the receiving with a statement to inform the amount of LTA used and the amount of crystallized rights owned by the client. If the transfer is made on a like for like basis the rights due will be the same when changing plan, and there is no need

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[13]https://www.legislation.gov.uk/uksi/1996/1715/made
[14]https://www.legislation.gov.uk/uksi/1996/1847
[15]https://www.gov.uk/hmrc-internal-manuals/pensions-tax-manual/ptm107000

to repeat a crystallization event. Moreover, the member will not be able to take a lump sum as he/she might have done while in the previous plan. The pension amount may suffer a loss due to costs relating to the transfer and the timing of the pension may undergo a modification, more precisely the term certain of the new contract may come in place earlier than the one in the original plan.

Chapter 4

Effect of transfer on liabilities

The constant uncertainty of the pensions sector drove the regulators to oblige firms to hire specialists, namely actuaries, to advise on benefit plans and consult on the financial ability of pension schemes scheme to sustain the liabilities. It's crucial for an actuary to value the scheme especially while considering UK pension funds. The challenge may be setting the assumptions; actuaries help the Trustee in this part of the valuation and by law they need to be prudent and conservative. In this chapter we will analyze the procedures necessary to establish the liabilities of the defined benefit scheme, listing the necessary assumptions and the repercussions on liquidity. Throughout the chapter, we will recall a few essential aspects discussed before and will describe real world situations and facts, useful to illustrate the substance of the internship. This stage of a pension scheme valuation is really crucial because if the assumptions are chosen appropriately, then the scheme will be subject to a low level of volatility from one valuation date to another. An appropriate set of assumptions for a particular pension scheme will portray the scheme's financial position in a more realistic way, which is fundamental from a managerial and investment point of view. The effect of transfers is analyzed with a real-world case study. We will use data from a client we have been working for and, without disclosure about any identity or names of the firm, we explain how LSC dealt with it, and how firms may choose to deal with it.

4.1 Incentive exercise

The employers who have a pension plan arrangement with their employees, may sometimes offer the members the possibility to transfer out. They do this in the scope of liability management and with the objective of reducing future liabilities of the scheme. Moreover the costs, risks and further obligations linked to the benefit which are transfer out will be eliminated. This practice is called Incentive Exercise (IE), and is becoming popular within Defined Benefit scheme, where it's easy for employers to forecast future liabilities due. The bigger flexibility offered by the Defined Contribution scheme contributed to this increase as well. Employer usually offer an increased transfer value to motivate members to transfer out and move the accumulated pension benefit to another provider. Their goal is to reduce costs of the schemes they are managing moving

the liabilities out of it. An Incentive exercise can create risks for members, who can face a loss in the long-term horizon, differently from employer who will see reduced its liabilities due. Indeed an individual should always take time to decide whether to take the transfer out or not. Losses could be due to individual specific characteristics, like the life expectancy, market environment and future development of the latter. Members will also take the investment risk when they will have to decide where to invest the transfer value obtained from the scheme they are leaving. Moreover this value may not reflect the real value of the pot accumulated, being it evaluated under the 'cost-neutral' approach, and in this situation the member will suffer an even worse condition. The incentive exercise may be disadvantageous for trustees and employers as well. First point to note is the fact that the IE is expected to be costly, from both the designing point of view and the consulting that may be taken before offering it, considering that it has to follow some legislative requirements. Offering members to move out from the scheme may also have reputational and legal consequences.

4.2 Gilt and interest rates

Members will be offered a lump sum which should represent a fair value of the benefits they are giving up before retirement. The amount is the Cash Equivalent Transfer Value (known as the CETV or transfer value). The transfer value is decided by the pension scheme administrators and they will consider factors such as:
- Age;
- Scheme Retirement Age;
- Life expectancy;
- Scheme investments

Recent experience shows that the transfer value of an average Defined Benefit Pension worth £10,000 per year has increased from £210,000 to £260,800 since mid-2016[1].

Interest rates are also responsible in the process of growth of transfer values, this is because they have a side effect on Gilt Yields, resulting in an increase of the costs of investments and a decrease in returns for DB schemes. Gilts are British Government Bonds issued by the HM Treasury, and they are an example of low- risk investment, used by the government to gain their borrowing. Most of the Defined Benefit schemes are invested in those Bonds, having Gilt Yields as a return of the investment. The Gilts pay a fixed amount over a set period of time and at the end of the contract the client will get back the face value. After they are purchased, they can be traded on the open market and the face value of the bond will most likely not reflect its current value. Following this reasoning, when the value of the Gilts goes up, the yield (the interest rate on a Gilt based on its buying price) goes down. For this reason Gilts are important to pension transfer values. Gilts values tend to be low when the interest rates are high because the rate of interest they pay will almost never beat anything can be obtained in a savings account. Moreover there would be low demand of it. Conversely Gilt value can rise if interest rates drop. Most pension funds are now largely invested in "risk-free investments ", by "risk-free" experts mean that the government's ability to repay the loan is not impacted by market conditions. In

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[1]https://www.xpsgroup.com/media/2358/xps-transfer-watch-august-19.pdf

terms of meeting liabilities, pension funds regard an investment in Government Bonds as risk free. So, a stock market in free-fall no longer impacts pension funds that much because transfer values are immune from crashes in equities. Indeed, transfer values can increase from market crashes: money is swiped into gilts, pushing down gilt yields and increasing the price at which gilts need be purchased. (Tapper, 2019) The transfer value represents the amount of cash that would be needed to pay the pension and when gilt yields fall this amount rises. That is because the gilts which are yielding less are more expensive to buy[2]. Members taking a CETV will change the shape of the cashflows and the liquidity needs of the scheme. For example, if a member stays in the scheme until retirement the cashflow duration relatively to that member will be equal to the difference between 120 and the age of the member. The pension payments will be regular and relatively small. In the liability projection, the stream of payments will be decreasing because it will be weighted with the probability of the member surviving each year. Conversely, if a member transfers out, the liability projection duration will be shorter, stopping when the transfer come in place, ideally before retirement. The shape of the cashflow would display a high single payment (the lump sum), and no payments afterwards. The necessity of knowing the future development of the financial position of the scheme lead to the analysis of the procedures necessary to establish the liability projection, listing the necessary assumptions and the repercussions on liquidity. In the next sections we will consider a real-life example.

4.3   Cashflows estimation - method 1

The LSC adopts a procedure to calculate the liabilities of the scheme, and does it using a WTW specific software called EuVal Liabilities. With this tool we can calculate the approximate CETV for different categories of members, modifying economic and demographic assumptions. The approach uses expectation on mortality, the benefit that members would receive if leaving the scheme, but also considers the cash flows of the remaining members (do not transfer). It will be shown through the description of the steps that need to be followed, illustrated with an example. The need is to estimate the cashflows of both cases (leaving or staying) and then combine the results. With the cash flows is possible to help the client to understand how the scheme will develop in future (project the liabilities). Here a high-level summary of steps:

1. Calculate the current CETV for all affected members (usually the deferred members and actives);
2. Use the approximate current CETV calculated for each member in step 1 as an input to the software, similar to a data item;
3. Prepare the benefit structure to calculate the value of the benefits in the event that the members *do not* transfer out before retirement (Run A);
4. Prepare the benefit structure to calculate the value of the benefits in the event that the members transfer out before retirement (Run B);
5. Set the demographic basis;
6. Complete Run A;
7. Complete Run B;

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[2]https://henrytapper.com/2019/08/29/why-do-db-transfer-values-make-me-sick/

8. Add the results from Run A and Run B together to obtain the total liability;

Dependents and retirees usually do not have the option to transfer out of the scheme, this is why we use deferreds and actives for the study.

The illustration given next is based on anonymous and modified data, but it still shows a reasonable picture of what we found. In this case study, the client has been experiencing an increasing transfer value activity, since the pension freedoms came in. We want to investigate how cashflows and the financial position of the scheme are affected, if the current level of transfers continues. Just like the membership, the assumptions are created ad hoc for the example, and they are listed along next paragraphs. We will now observe in detail how to obtain the results in practice. We will first analyze the case of Run B, which comprises the study of the members expected to transfer out before retirement. The objective is to calculate CETV at the effective valuation date.

If a member transfers out, a lump sum is payable which is equal to the transfer value at the valuation date (calculated in a separate run) and increased each year in deferment by the CETV discount rate, to accumulate the value to the time the transfer is taken. The probability of the payment being made is equal to the probability of the member choosing to transfer (the decrement to be considered in EuVal will be the 'Retirement' decrement, due to a limitation of the software). Based on the experience, there is a 20% probability of transfer out each year for members under 60 years of age, and a 10% probability for ages 60 to 64.

In this scenario no death in deferment will be taken into account (If death is after ceasing to be a contributing member of the Scheme, but the pension has not yet come into payment). This is an approximation of the case and it is understandable, given that the probability of the member dying before retirement age is very low when compared to the assumed probability of the member choosing to transfer out. The most common benefits that are paid if the member dies before retirement are spouse pension and refund of member contributions, often increased with interest to the date of death.

In Run B we are calculating the current value of the expected CETV payments, where the value of the transfer payments is equal to the results of the Run we completed in Step 1. We can approximately estimate the probability of transferring, by summing the decrement table between average age by liability and retirement age. Multiplying this probability by the liability of the run completed in Step 1, we can check whether the results of Run B are reasonable. For example, given:

- Average age by liability in the Step 1 run is 54;
- Retirement age in the Step 1 run is 60;
- Liability of the Step 1 run is £78m;
- The transfer out decrements are 0.01, 0.01, 0.01, 0.01, 0.01 and 0.4, respectively, to the ages 54, 55, 56, 57, 58 and 59.

After performing calculations, the (approximate) expected liability for Run B is:

$$\pounds 78m \times (0.01 + 0.01 + 0.01 + 0.01 + 0.4) = \pounds 78m \times 0.45 = \pounds 35.1m \quad (4.1)$$

Going forward to Run A, in which we value benefits for members if they do not transfer out and retire at NRA, there is no need to account for the cash flows of people moving out, to prevent double counting; accordingly, we remove all people who take a transfer from the population that is going to retire.

The probability of the member leaving the scheme at each age before NRA is set to be equal to the combined probability of transferring out at that age.

As in the previous step, the probability of death in deferment is assumed to be zero, i.e. no members will be assumed leave the scheme through death in deferment. We can sense-check the value by: (i) summing the transfer out decrements between the average age (by liability) and retirement age; (ii) multiplying the value of the base run by 1 – the sum in (ii). This should be roughly the value of Run A. For example, given:

  - Average age by liability in the Step 1 run is 54;
  - Retirement age in the Step 1 run is 60;
  - Liability of the Step 1 run is £84m;
  - The transfer out decrements are 0.01, 0.01, 0.01, 0.01, 0.01 and 0.4, respectively, to the ages 54, 55, 56, 57, 58 and 59.

The (approximate) expected liability for Run A is:

$$£84m \times (1 - (0.01 + 0.01 + 0.01 + 0.01 + 0.4)) = £84m \times (1 - 0.45) = £46.2m \quad (4.2)$$

Summing the expected cashflows from Run A and Run B, we obtain the curve in Figure 4.1 for the particular case under analysis. We can see an example of expected cashflows for a deferred population allowing for transfer out. The payments shown in blue are the transfer value payments, the ones in purple are the commutation and lump sum payments for members who did not transfer out, and the yellow, not visible, are the death in deferment benefits. The cashflows projection displayed were obtained summing the members' individual cashflows of the same year, one of the outputs coming from the EuVal Liability software.
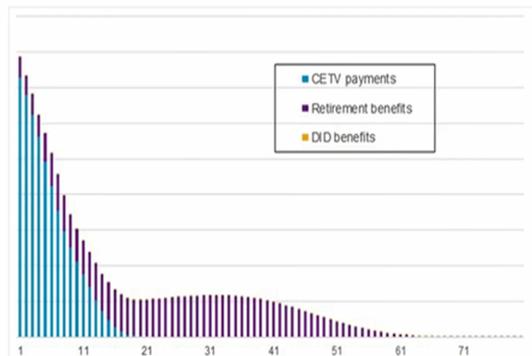
Figure 4.1: Total expected cashflows
Source: Metcalfe Elizabeth, Transfer out decrements - process guidance, 2020

The blue lines are large due to the high probability of transferring out in the early years and they reduce because the number of members decrease, as time goes by. The youngest deferred member is 42 years old, so after 18 years this

person would reach the NRA, the transfer out liabilities reach 0 and all members are expected to be already in retirement. The purple lines show the cashflows linked to the retirement benefits: they are low in early years because a small number of members will reach the pensionable age, and they increase because at this time a large number of members are expected to reach the retirement age, and the scheme will need to pay out the benefits. The projection is 78 years long, assuming the younger member is alive and will receive benefits until the last assumed age of death (120). After 35 years, a large portion of the retirement benefits are likely to cease due to decreasing probability of surviving, implying the probability of a benefit being paid to be very low. The plot shows the peak cash flow is the present time. This pattern of higher cashflows in a short time horizon will remain the same regardless of the discount rates considered, due to the relatively old average age of the population being studied and the high probability of the members choosing to take a transfer at retirement.

Many schemes are targeting some format of self-efficiency over a larger time horizon, slowly de-risking along the way. But if cash flows are high in the short term and small in the long, they need to review the journey plan. Especially if the transfer scheme is expected to generate significant profit when members transfer. The reason that transfer values result in a profit is because the amount of money paid out is usually less than the amount of money the Trustees would reserve to pay the benefits.
High levels of transfer can cause duration of the scheme to be shorter than expected and this leads managers to review hedging strategies more frequently than in the past.

4.4 Cashflows estimation - method 2: an application to three scenarios

The previous method provided the results that we need for a liability projection, producing future cash flows that allow the client to understand future development of the pension plan and to be able to make educated decisions to fulfil the promises made to the members.
The procedure to project liabilities can be long and tedious, even if the data is agreeable. The EuVal software simplifies the process and is very powerful and clear in the results. Using EuVal requires extensive training to understand and utilize, because it makes practical and effective use of many actuarial concepts. After becoming familiar with the WTW software, it is easy to replace the previous method, with another one that is faster to implement. Main similarities and differences between the two are exposed along the following paragraphs.
First of all, we need to make clear that two different sets of members were chosen to illustrate the two methods. For this reason the liability projections obtained will not be comparable.
The approach makes use of economic and demographic assumptions on the members of the scheme. As already said, data are taken from a client in the WTW portfolio, which we have been working on for some weeks.
We will set economic assumptions relating to the current market conditions. This means decisions are made according to a market-based approach. In simple

terms, the value of an asset is determined by the real price of similar items.
The usual assumptions related to mortality, retirement, termination of employment, disability, marriage, divorce, transfer out of the scheme, household composition, and other have to be included. Some of them are optional, but most are mandatory, such as the mortality assumptions, which have a significant impact on the result. Most of the demographic assumptions are related with mortality rates, a measure of deaths over a given population in a defined interval of time. All the assumptions used in the illustration can not be included because of confidentiality costraints.

The core part of this method consists of making a comparison between different scenarios and analyzing the behavior of the cashflows according to different inputs.

Along with the liability projections, we are assuming a starting funding level of 80%. The funding level is a Key Performance Indicator of the scheme usually expressed as a percentage, explaining how its current market value of assets compares with its liabilities. Differences in the approach of setting the funding level can often create significant differences in how funding levels appear. The Trustees and sponsoring employer need to always have a plan to achieve 100% funding, but it is very common for them not to have yet achieved this. In the past liabilities have tended to grow faster than assets, so many schemes find themselves underfunded. The plan to reach 100% funding usually requires additional contributions from the employer.

Scenario #1

The first scenario will consider that none of the members will transfer out before the retirement age, the decrements are then related to death or ill-health retirement. With the tool provided by EuVal Liabilities, we will be able to extract the individual cashflows projection and the data summary, in which some key information is reported (for instance, total liabilities, mean term of liabilities, etc.).
Table 4.1 displays how the individual cash flows appear in an extract (of the first five members and the first nine payments).

RecordID	Age	Sex	Category	MemberAmount	Cash flows								
1026	58	M	Staff	2009.016146	5.18	9.49	14.39	20.02	26.52	34.03	42.41	2908.52	2973.97
1032	61	M	Staff	6022.11749	17.59	33.48	51.85	73.1	7555.38	7650.5	7749.27	7851.91	7958.66
1044	60	M	Staff	9458.569387	27.27	49.56	74.95	103.94	137.1	11557.77	11784.6	12019.27	12262.24
1056	62	M	Staff	7684.366316	24.82	47.17	73.06	9136.75	9247.16	9361.89	9481.2	9605.39	9295.05
1086	59	F	Staff	1761.256225	3.22	6.06	9.37	13.2	17.64	22.76	2684.85	2728.9	2774.18

Table 4.1: Individual cashflows for the no transfer case
Source: EuVal Liabilities

Figure 4.2 shows the plot with the total payments (TP) in pounds, along the years. TP equals the sum of the individual cashflows from all the members, year after year.

The cashflows extracted from the WTW software show small values preceding the retirement age. These are the liabilities in case of death of the member, which are weighted with the probability of death (a small value). When the member reaches the Normal Retirement Age (65), the benefit comes to payment and therefore a high value is observed.
The horizon for the liability projection is the number of years that the youngest
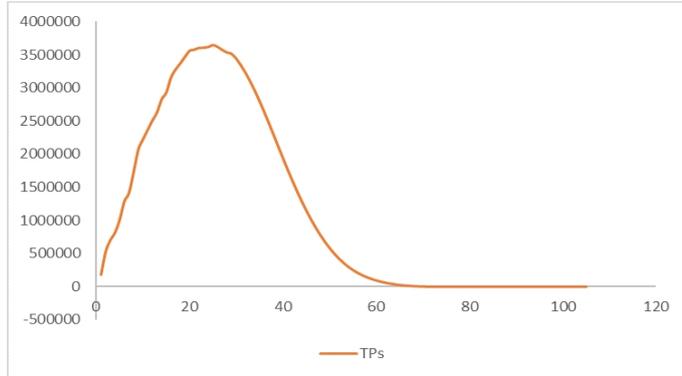
Figure 4.2: Shape of the liability projection without transfers
Source: Author's calculations

member (aged 36) will need to reach the last payment, with a lifetime no longer than 120 years. The forecast will then include 84 years (values after this point are zero). The amounts are increasing for the first 20 years because in this period many members are expected to retire, and the scheme will need to pay out the benefits. After some years the curve stabilizes and then starts falling; this is attributable to the death of members - the scheme will be paying benefits to less members.

If the discount rate assumed is 2.02% and the return on assets is 3.04%, the present value of total future liability is 73.5m and the present value of total future cash flows in is 58.8m. The rates have been chosen ad hoc for the experience. Those are one of the possible couple of rates needed to reach the results we are looking for: to obtain a longer duration of assets when transfers are in place, applying a 10% margin (the third scenario).

Performing the adequate calculations, we conclude that the scheme will run out of money in 54 years, if there are no further contributions. Denoting the discount rate applicable to the liabilities with d, the return on assets with r, the present value of the cashflow c_i(assumed available at the middle of year i, i=1,2,...,84) with C_i, the liability at time i with L_i and the asset at time i with A_i, it follows that

$$C_i = c_i \times (1+d)^{0.5-i} \tag{4.3}$$

$$L_i = \sum_{n=i}^{85} C_{n+1} \times (1+d)^i \tag{4.4}$$

$$A_i = A_{i-1} \times (1+r) - C_i \times (1+r)^{0.5} \tag{4.5}$$

Values of c_i can be found in Appendix A. For instance, if $i = 1$

$L_1 = (513, 964.30 + 668, 243.909 + \ldots + 0.0055362) \times 1.202 = 74, 834, 572.6$
$A_1 = 58, 826, 160.59 \times 1.0304 - 181, 663.04 \times 1.0304^{0.5} = 60, 430, 072.23$

For $i = 54$, we have a turning point, as the asset becomes negative,

$$L_{54} = \sum_{n=54}^{85} C_{n+1} \times 1.0202^{54} = (85,034.81 + 69,402.49 + \ldots + 0.0055362) \times (1.0202)^{54} = 1,207,761.61$$

$$A_{54} = A_{53} \times 1.0304 - C_{54} \times 1.0304^{0.5} = 167,491.76 \times 1.0304 \check{\ } 302,339.49 \times 1.0304^{0.5} = -134,317.14$$

From this reasoning the conclusion is clear: in year 54 the assets of the fund would be under zero, this means the company well not be able to pay the remaining liabilities. This result is due to the assumptions chosen ad hoc in the beginning, a key point.

Scenario #2

If we set a scenario that 20% of the members will transfer out before the normal retirement age, its implementation is now straightforward, as it suffices to insert this percentage, while creating the liability run (or benefit structure). The required calculations will be performed automatically by the software.

Table 4.2 displays how the individual cashflows appear in an extract (of the first five members and the first nine payments).

RecordID	Age	Sex	Status	Category	MemberAmount	Cash flows								
1026	58	M	Deferred	Staff	2009.016146	5.18	9.49	14.39	20.02	26.52	34.03	142.82	16641.15	2379.18
1032	61	M	Deferred	Staff	6022.11749	17.59	33.48	51.85	224.12	38882.11	6120.4	6199.42	6281.53	6366.93
1044	60	M	Deferred	Staff	9458.569387	27.27	49.56	74.95	103.94	441.45	64143.1	9427.68	9615.42	9809.79
1056	62	M	Deferred	Staff	7684.366316	24.82	47.17	218.32	46674.9	7397.73	7489.51	7584.96	7684.32	7436.04
1086	59	F	Deferred	Staff	1761.256225	3.22	6.06	9.37	13.2	17.64	62.68	14679.41	2183.12	2219.35

Table 4.2: Individual cashflows with 20% transfer assumption
Source: EuVal Liabilities

Figure 4.3 shows the plot with the total payments (TP) in pounds, along the years, for the two scenarios. The green line equals the sum of the individual cashflows year after year, assuming 20% transfers.

Figure 4.3: Shape of the liability projection for the 'no transfer' (yellow line) and 20% transfer assumption case
Source: Author's calculations

The individual cashflows show values similar to the 'no transfer' case, with the difference of the first large payment, which is about five times bigger than before, due to the lump sum that might come in payment. The liability projection is 84 years long as before, being the same set of members, and the cashflows extracted in this case (figure 4.3) show values significantly higher for the first 15 years compared to the 'no transfer' liability. This is due to the transfers that come in place, obliging the scheme to pay out lump sums. On the plot there are peaks, caused by multiple transfers during the same year.

After the first period, some members will be out of the scheme definitively and the relative pension liability will be null, so in a long term horizon the green curve is lower than the orange, the ratio of the liabilities being stable around 80%, after 30 years, assuming no further contributions.

Through an analysis identic as the previous case (formulae 4.1, 4.2, 4.3) we can observe that the scheme assets will deplete in 45 years, much less than the 'no transfer' case, enlightening the weight that transfer might have on the scheme. This is expected as transfers oblige the scheme to pay out a lump sum, in turn decreasing the liabilities. The sum is to be payed immediately, so the scheme loses the opportunity to get more investment returns.

What has been exposed until now is based on the cost neutral approach, where the value transfer to pay out equals the total cost of future pension. As stated at the beginning of the chapter, firms need to be prudent and conservative while stating the assumption for a valuation.

Scenario #3

Minimum funding standards aim at ensuring that the pension plan's assets at least match and, preferably, exceed by some margin the plan's accrued liabilities. If funding levels decline below the stipulated solvency margin, the institution must draw up a plan to restore its financial position. Margin development must incorporate an allowance for risk and an allowance for the features of the expected experience not captured by the standard projection.

In this scenario we assume a 10% margin, so that on a total liability of 1 million, the company would need to fund 1.1 million. With this approach the duration of the assets will be longer and, by varying the assumptions on the rates, we will be able to ensure that the liabilities due to transfers can be bear as well as the 'no transfers' case. Table 4.3 displays how the individual cashflows appear in an extract (of the first five members and the first nine payments).

RecordID	Age	Sex	ValnStatus	Category	MemberAr	Cash flows										
1026	58	M	Deferred p	Staff	2009.016	5.18	9.49	14.39	20.02	26.52	34.03	132.39	15209.72	2379.18	2433.23	2489.06
1032	61	M	Deferred p	Staff	6022.117	17.59	33.48	51.85	208.35	35598.33	6120.4	6199.42	6281.53	6366.93	6167.28	6187.62
1044	60	M	Deferred p	Staff	9458.569	27.27	49.56	74.95	103.94	409.78	58653.41	9427.68	9615.42	9809.79	10011.2	9767.87
1056	62	M	Deferred p	Staff	7684.366	24.82	47.17	203.14	42738.35	7397.73	7489.51	7584.96	7684.32	7436.04	7456.03	7471.12
1086	59	F	Deferred p	Staff	1761.256	3.22	6.06	9.37	13.2	17.64	58.47	13426.26	2183.12	2219.35	2256.6	2294.92

Table 4.3: Individual cashflows for scenario assuming 20% transfer and 10% margin
Source: EuVal Liabilities

Figure 4.4 shows the plot with the total payments (TP) in pounds, along the years, for the three scenarios. The brown line equals the sum of the individual cashflows year after year, assuming 20% transfers and 10% margin.
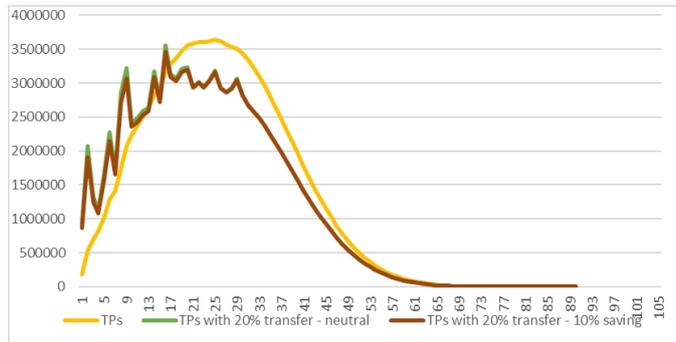
Figure 4.4: Shape of the liability projection including Scenario #3 (brown line)
Source: Author's calculations

The shape of the liability (brown line) shows a similar pattern with the green line corresponding to the transfer case, with main spikes relative to years 2, 6, 9, 14 due to high number of individual transfers in those years. It is clear how the values are lower in the beginning (around 9% lower) and after 30 years they are in line with the values from Scenario #2, because pension payments are not affected by the 10% margin that was only impacting the transfer value payments. With the assumption of a discount rate for liabilities of 2.02% and an asset return of 3.04%, and performing the adequate calculations, the result is interesting: using those specific rates, the firm will run out of money after 60 years, assuming no further contributions are made. This period exceeds the 'no transfer' case by six years. The asset owned by the plan will be able to cover the liabilities of the scheme for six more years, despite the 20% of transfer assumed. This is possible thanks to the 10% margin, which covers the immediate pay out of money, and to the return on investment assumption, which covers the loss in the fund, stretching/extending the lifetime of the fund itself.

With this analysis we have tried to show how transfers accelerate the pay out of money, leading to a deficit situation in the first years. The ability to set appropriate assumptions and to decide how to invest on assets may help the company to face the loss of money and be able to use the asset to fund the liabilities, even when several transfers out come in place.

Chapter 5

Conclusions

This research aimed to identify the effect of transfers out in Defined Benefit pension schemes. Based on a descriptive analysis and applications making use of the data from a client we worked with during the internship period, it can be concluded that assumptions and funding position are important factors to consider, when designing asset investment decisions and liability projections, also in a context of pension transfers. Results show that the impact of transfers on the liability of a scheme is not negligible and may be dangerous, in the sense that transfers can lead to a deficit and reduce the fund of the scheme quite fast.

The role of the actuary in such environment assumes a key position because, with the knowledge obtained with previous studies and the experience accumulated, he/she can help the firm setting the demographic and economic assumptions, determine investment decisions and perform other tasks, in order to ensure that future developments do not impact negatively the financial position of members, sponsors and managers. Setting the assumptions is the most important step of the valuation process, especially in a world in continuous evolution.

A good knowledge on structure and features of different pension funds is fundamental to obtain usable results. In fact, in the last few years we are witnessing an increase in pension transfers in UK, due to the new rules introduced by the 2015 pension reform. A significant number of members are moving their accumulated pots from Defined Benefit to Defined Contribution plans, attracted by the new flexibility offered by the latter.

These were the main reasons that drove the author to investigate and write about this topic, without neglecting the importance of the legislation behind the transactions and adding some real-world examples. The notions exposed in Chapter 2 and Chapter 3 become fundamental when approaching the study on data coming from members of a real scheme. With the valuation process we are able to produce liability projections in Chapter 4, which shows how cashflows will develop and allows us to make predictions on the future financial situation of the scheme.

The study led to several conclusions. In particular, is essential to highlight the importance of the chosen discount rate, which is the variable with most impact on the results and one of the most instable. Moreover, the main strategy imposed by the UK government is the "theory of prudence", a key factor while taking transfers into consideration. Since transfers may affect strongly the fin-

ancial position of the scheme, they need to be treated with care. Given that this practice increased in the recent years, the topic may be further investigated considering, for example, the procedure of choosing the interest rates (HM Treasury, 2010), setting the assumptions or providing advisory service to clients and members of the scheme. The scheme itself may extract some useful conclusions form a valuation considering corrected assumptions: high levels of transfer can cause duration of the scheme to be shorter and the shape of liabilities to be different than expected and this leads managers to review future funding or investment strategies.

Appendix A

Cashflow comparison

1. Cashflows for the scenario without transfer, the scenario with 20% transfer out and the scenario assuming 20% transfer out and 10% savings, which for simplicty will call TPs, TPs 20% Tv-out and TPs 20% Tv-out & 10% saving relatively

Year	TPs	TPs 20% Tv-out	TPs 20% Tv-out & 20% saving
1	181663	939193.36	859940.21
2	529615.8	2068301.13	1904023.99
3	702503.2	1323827.08	1247883.55
4	817687.9	1124817.78	1078043.7
5	1012381	1642926.27	1559942.87
6	1286870	2274867.96	2150670.01
7	1417481	1716882.43	1658953.02
8	1733527	2848290.04	2702475.82
9	2072335	3223108.77	3066893.31
10	2224587	2425427.65	2361170.12
11	2366824	2484572.28	2425783.81
12	2506111	2582164.07	2524754.94
13	2630277	2641022.68	2587642.08
14	2826969	3177466.03	3086156.25
15	2930964	2760797.86	2719439.09
16	3156963	3562254.93	3458766.72
17	3278524	3135496	3084377.63
18	3370244	3066692.17	3029763.78
19	3469350	3205854.3	3162907.57
20	3559876	3238900.15	3199873.74
21	3576873	2938444.46	2930822.6
22	3602328	3018677.85	3005066.75
23	3605636	2946414.52	2940291.97
24	3617788	3044274.64	3029323.7
25	3645459	3189944.38	3162624.79
26	3618641	2930613.61	2927083.93
27	3572889	2860066.89	2859931.02
28	3534836	2934756.7	2924092.09
29	3512222	3064857.72	3039354.26
30	3439282	2823567.95	2816353.73
31	3339349	2671478.86	2671478.86
32	3224921	2579936.86	2579936.86
33	3095639	2476511.12	2476511.12
34	2952084	2361667.4	2361667.4
35	2798081	2238464.37	2238464.37
36	2635199	2108158.88	2108158.88
37	2465439	1972350.94	1972350.94
38	2291434	1833146.74	1833146.74
39	2115858	1692686.09	1692686.09
40	1941192	1552953.22	1552953.22

41	1769762	1415809.49	1415809.49
42	1603621	1282896.55	1282896.55
43	1444362	1155489.43	1155489.43
44	1293219	1034574.84	1034574.84
45	1151064	920850.97	920850.97
46	1018340	814672.12	814672.12
47	895258.9	716207.1	716207.1
48	781943.4	625554.62	625554.62
49	678401	542720.81	542720.81
50	584568.1	467654.48	467654.48
51	500322.7	400258.13	400258.13
52	425463.6	340370.94	340370.94
53	359648.4	287718.71	287718.71
54	302339.5	241871.53	241871.53
55	252898.7	202318.99	202318.99
56	210576.7	168461.36	168461.36
57	174508.7	139606.85	139606.85
58	143839.8	115071.84	115071.84
59	117781.3	94225.04	94225.04
60	95633.97	76507.14	76507.14
61	76828.27	61462.62	61462.62
62	60910.39	48728.28	48728.28
63	47515.27	38012.17	38012.17
64	36371.25	29096.96	29096.96
65	27261.58	21809.27	21809.27
66	19963.56	15970.85	15970.85
67	14248.26	11398.65	11398.65
68	9895.99	7916.8	7916.8
69	6682.35	5345.89	5345.89
70	4379.43	3503.54	3503.54
71	2780.24	2224.19	2224.19
72	1706.95	1365.54	1365.54
73	1012.11	809.67	809.67
74	578.5	462.8	462.8
75	318.28	254.62	254.62
76	168.27	134.61	134.61
77	85.33	68.29	68.29
78	41.64	33.31	33.31
79	19.64	15.73	15.73
80	9.03	7.23	7.23
81	3.99	3.18	3.18
82	1.73	1.38	1.38
83	0.72	0.57	0.57
84	0.27	0.21	0.21

2. The Liability and Asset evolution

Figure A.1: Liability evolution assuming 2.03% discount rate, according to formula (4.2)

Liability evolution	TPs	TPs 20% Tv-out	TPs 20% Tv-out & 20% saving
	73532700.74	72900731.66	71497645.82
1	74834572.63	73424694.65	72073316.08
2	75811292.82	72818786.95	71606038.58
3	76633117.93	72952595.56	71792056.4
4	77355201.64	73290116.35	72153378.44
5	77895221.99	73111139.84	72035257.16
6	78168903.28	72290255.61	71318086.18
7	78316188.75	72016382.53	71083086.85
8	78147227.58	70594199.51	69789330.84
9	77632640.27	68764702.93	68101361.26
10	76953876.67	67703947.93	67092110.05
11	76117735.74	66562026.68	65997208.93
12	75124018.32	65298466.09	64780225.08
13	73984813.1	63949931.45	63475139.03
14	72623927.37	62032322.08	61640166.25
15	71130512.21	60496832.48	60138529.5
16	69378659.59	58120814.67	57859802.19
17	67468637.03	56127848.95	55913196.1
18	65427390.45	54164120.59	53982431.26
19	63244808.15	52020164.28	51878183.15
20	60926702.75	49799522.11	49694091.57
21	58544603.51	47837498.09	47737636.3
22	56088674.48	45754801.49	45666670.38
23	53579795.01	43703023.96	43619296.67
24	51007961.57	41510956.95	41440639.57
25	48356228.69	39127476.54	39083332.88
26	45678017.96	36957786.75	36916316.54
27	42991918.8	34815524.9	34773354.22
28	40289996.12	32554548.95	32522298.22
29	37556335.87	30116492.82	30109350.38
30	34841128.52	27872902.57	27872902.57
31	32172012.03	25737609.3	25737609.3
32	29564556.78	23651645.07	23651645.07
33	27035012.23	21628009.47	21628009.47
34	24599368.31	19679494.27	19679494.27
35	22270075.71	17816060.23	17816060.23
36	20058250.29	16046599.82	16046599.82
37	17973211.83	14378569.05	14378569.05
38	16021809.41	12817447.19	12817447.19
39	14208329.05	11366662.87	11366662.87
40	12534637.73	10027709.84	10027709.84

40	12534637.73	10027709.84	10027709.84
41	11000290.27	8800231.901	8800231.901
42	9602759.842	7682207.562	7682207.562
43	8337858.762	6670286.63	6670286.63
44	7200068.704	5760054.616	5760054.616
45	6182878.773	4946302.654	4946302.654
46	5279198.89	4223358.797	4223358.797
47	4481582.9	3585266.019	3585266.019
48	3782309.332	3025847.259	3025847.259
49	3173493.397	2538794.489	2538794.489
50	2647155.214	2117723.962	2117723.962
51	2195277.024	1756221.46	1756221.46
52	1809882.322	1447905.635	1447905.635
53	1483179.237	1186543.188	1186543.188
54	1207761.605	966209.1418	966209.1418
55	976718.1531	781374.371	781374.371
56	783754.9785	627003.8202	627003.8202
57	623324.4134	498659.4678	498659.4678
58	490630.2479	392504.1342	392504.1342
59	381576.0858	305260.7628	305260.7628
60	292688.8788	234151.0314	234151.0314
61	221000.8382	176800.5934	176800.5934
62	163942.5459	131153.9904	131153.9904
63	119261.4104	95409.12757	95409.12757
64	84933.72791	67947.02193	67947.02193
65	59113.84387	47291.10944	47291.10944
66	40143.75964	32115.04073	32115.04073
67	26563.21565	21250.56378	21250.56378
68	17104.35281	13683.46526	13683.46526
69	10700.35644	8560.257712	8560.257712
70	6493.062541	5194.426079	5194.426079
71	3816.042373	3052.811481	3052.811481
72	2169.022428	1735.215273	1735.215273
73	1190.555478	952.45984	952.45984
74	630.2910606	504.2486184	504.2486184
75	321.544384	257.2556358	257.2556358
76	158.0785506	126.489436	126.489436
77	75.08421315	60.06824199	60.06824199
78	34.54245292	27.6368715	27.6368715
79	15.40283822	12.30705761	12.30705761
80	6.593228533	5.253002266	5.253002266
81	2.696314229	2.14715549	2.14715549
82	1.003394135	0.796659716	0.796659716
83	0.296427054	0.237024025	0.237024025
84	0.029701515	0.029701515	0.029701515

Figure A.2: Asset evolution assuming 3.04% increase according to formula (4.2)

Asset evolution	TPs	TPs 20% Tv-out	TPs 20% Tv-out & 20% saving
	58826160.59	58826160.59	58826160.59
1	60430072.23	59661113.65	59741562.43
2	61729540.73	59375307.57	59624957.45
3	62893017.47	59836518.31	60170846.78
4	63974941.48	60513761.46	60905733.23
5	64892125.92	60685668.02	61173791.04
6	65558562.78	60221325.24	60850358.83
7	66112677.27	60309269.87	61016229.42
8	66362823.23	59251411.75	60127876.87
9	66276654.01	57780921.42	58842603.24
10	66033316.79	57075443.29	58234627.17
11	65638199.4	56288481.72	57542580.16
12	65089682.46	55378532.44	56729030.69
13	64398450.5	54381174.14	55826913.45
14	63486545.84	52808959.91	54391336.99
15	62441355.96	51611904.47	53284368.53
16	61134983.54	49564910.54	51393266.96
17	59665502.61	47888885.09	49824713.09
18	58058245.94	46231750.28	48263912.96
19	56301526.95	44382977.02	46520512.08
20	54399512.83	42444456.67	44686587.96
21	52422423.74	40751993.72	43070022.65
22	50359391.56	38926636.09	41328949.54
23	48230285.87	37119141.1	39600699.79
24	46024119.55	35157361.8	37729536.37
25	43722798	32988077.07	35666177.49
26	41378738.5	31016089.17	33779186.77
27	39009861.45	29055763.84	31902997.53
28	36607597.89	26960028.03	29904643.11
29	34155260.69	24668518.09	27728537.69
30	31702412.66	22552276.18	25712643.42
31	29276439.41	20526084.04	23782526.45
32	26892870.33	18531218.68	21886656.94
33	24568073.19	16580695.46	20038139.04
34	22318322.68	14687452.61	18250002.47
35	20156506.76	12861716.87	16532568.25
36	18094310.91	11112750.07	14895195.33
37	16141745.17	9448471.441	13345903.04
38	14306451.67	7874903.009	11890816.53
39	12593589.95	6396077.764	10534075.05
40	11005958.31	5014137.14	9277929.549

41	9544078.548	3729398	8122809.927
42	8206405.288	2540521	7067492.761
43	6989728.365	1444832	6109423.163
44	5889487.748	438572.1	5244966.98
45	4900099.295	-482838	4469670.862
46	4015359.206	-1324479	3778586.427
47	3228661.168	-2091755	3166443.508
48	2533072.51	-2790337	2627711.527
49	1921442.43	-3426071	2156685.551
50	1386467.236	-4004933	1747539.181
51	920745.1394	-4532980	1394367.867
52	516853.5613	-5016288	1091250.805
53	167491.7604	-5460843	832365.536
54	-134317.1351	-5872373	612148.9953
55	-395114.3876	-6256264	425387.1093
56	-620879.3578	-6617457	267316.0751
57	-816895.4538	-6960341	133729.4965
58	-987738.8721	-7288743	20987.03603
59	-1137324.256	-7605968	-74021.49618
60	-1268975.637	-7914850	-153933.0919
61	-1385539.813	-8217852	-221002.5155
62	-1489489.52	-8517138	-277184.3967
63	-1583002.096	-8814644	-324196.4317
64	-1668045.314	-9112145	-363587.9259
65	-1746426.745	-9411293	-396779.2879
66	-1819782.852	-9713608	-425053.1677
67	-1889567.463	-1E+07	-449545.3964
68	-1957055.597	-1E+07	-471247.8109
69	-2023333.249	-1.1E+07	-491000.2835
70	-2089288.078	-1.1E+07	-509483.0872
71	-2155624.619	-1.1E+07	-527229.1177
72	-2222888.309	-1.2E+07	-544643.0237
73	-2291491.492	-1.2E+07	-562022.0564
74	-2361740.061	-1.2E+07	-579577.3088
75	-2433860.041	-1.3E+07	-597454.9203
76	-2508020.194	-1.3E+07	-615754.1906
77	-2584350.626	-1.4E+07	-634542.4382
78	-2662957.153	-1.4E+07	-653866.3409
79	-2743930.987	-1.4E+07	-673759.845
80	-2827355.655	-1.5E+07	-694249.4833
81	-2913311.317	-1.5E+07	-715357.8956
82	-3001877.737	-1.6E+07	-737106.1764
83	-3093135.551	-1.6E+07	-759514.7828
84	-3187167.146	-1.7E+07	-782604.2454

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