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ACTUARIAL SCIENCE

MASTER´S FINAL WORK
PROJECT

SOME CONSIDERATIONS ABOUT ROLL FORWARD FOR PENSION FUNDS

RAQUEL MANUELA DE FIGUEIREDO FERREIRA E SILVA

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SUPERVISION:

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Resumo

Atualmente, a maioria das empresas oferece aos seus trabalhadores um leque diversificado de benefícios, entre eles um benefício pós-reforma, que normalmente é acumulado durante os anos de serviço prestados pelo colaborador. Estes benefícios na sua maioria são acumulados em fundos de pensões que a empresa detém.

O objectivo subjacente no presente trabalho é analisar o comportamento do valor das responsabilidades totais com o método de roll forward. Tipicamente, o roll forward tem muita aplicabilidade em diferentes sectores, no entanto, neste trabalho, pretende-se aprofundar o conceito no setor dos fundos de pensões e, comparar resultados com uma avaliação atuarial. O estudo deste método foi feito para três anos consecutivos: 2013, 2014 e 2015 com uma população real.

Os resultados aplicando o método roll forward obtêm-se em três fases. Em primeiro lugar, aplicou-se a fórmula do roll forward sem a consideração da rúbrica de ganhos e perdas. Num segundo passo, analisaram-se os resultados tendo em conta a rúbrica anterior. E, por último, analisaram-se dois cenários determinísticos em relação à taxa de desconto, conseguindo assim, incrementar o roll forward com o impacto que a sensibilidade tem nas responsabilidades; obtendo-se assim o terceiro passo do do roll forward.

Por fim, para validar o método quanto à sua eficácia quando utilizado para efeitos de contabilização das responsabilidades comparou-se resultados com a avaliação atuarial.

Palavras-chave: Fundos de Pensões, Avaliação Atuarial, Sensibilidades, Roll Forward Desajustado, Roll Forward Ajustado.

Abstract

Nowadays, most of the companies offer their employees a wide range of benefits, including a post-retirement benefit, which is usually accumulated during the years of service rendered by the employee. Most of these benefits are accrued in pension funds that the company holds.

The underlying objective of this study is to analyse the behavior of the value of total liabilities with roll forward method. Typically, the roll forward have much applicability in different sectors, however, in this work is intended to deepen the concept in pension funds sector, and, compare results with an actuarial valuation. This method was done for three consecutive years: 2013, 2014 and 2015 with a real population.

The results of applying the roll forward method are obtained in three steps. Initially, the formula of roll forward was applied without considering its gains and losses. In a second step, the results were analysed taking into account the previously mentioned gains and losses. Finally, two deterministic scenarios were analysed regarding to the discount rate, thereby, increasing the roll forward with the impact that the sensitivity has in its responsibilities; thus obtaining the third step of the roll forward.

Finally, for validating the method for its effectiveness when used for the purpose of accounting of liabilities it was compared to the results using an actuarial valuation.

Keywords: Pension Funds, Actuarial Valuation, Sensitivities, Adjusted Roll Forward, Unadjusted Roll Forward

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Acronyms

ARA - Assumed Retirement Age

ASF - Autoridade Supervisora de Fundos de Pensões

COLA - Cost-of-living-adjustments

CPA - Chartered Professional Accountants Canada

DB - Defined Benefit

DC - Defined Contribution

EBP - Expected Benefits Payments

FAZ - Financial Accounting Standards

FYE - Final Year Ending

GASB - Governmental Accounting Standards Board

IAS - International Accounting Standards

IC - Interest Cost

IFRS - International Financial Reporting Standards

MD - Measurement Date

NC - Normal Cost

OCI - Other Comprehensive Income

P&L - Profits and Losses

PBO - Project Benefit Obligation

PVB - Present Value Benefit

RA - Retirement Age

RD - Reporting Date

SC - Service Cost

US GAAP - United States Generally Accepted Accounting Principles

VD - Valuation Date

Chapter 1

Introduction

1.1 Context and Motivation

The idea of discussing roll forward further came from my supervisor in the company where I am working at the moment, which is a financial retirement consultant where we perform actuarial valuations for managing pension plans and other post-retirement benefits as well as individual benefits calculations for seven countries in Europe and Brazil each year. During my present work, we start using the roll forward method for Netherlands instead of performing actuarial valuations, so the experience gathers during this work become very useful to improve the roll forward as a measure for accounting the liabilities.

Roll forward for pension funds means to extend the liability for a year or n-months from the last actuarial valuation and project to any date in time, according to IAS19 or FAS which are the international requirements to account employee benefits. The standard formula of roll forward only considers the last data available and we only calculate the liabilities rolling forward the prior year or n-months with the same assumptions. This method of accounting is not so common in Pension Funds, because in the majority of the cases is possible to perform a full evaluation of the liabilities, however, in some circumstances it may not be practical to perform a valuation as of the measurement date. In such situations the actuary can make use of update procedures to project or roll forward the liabilities from the valuation date to the measurement date. Aiming to gather more information, about the use of roll forward, we contacted the Institute and Faculty of Actuaries in London, as well as the Society of Actuaries. The former replied providing some documentation already available on Google, so it was not so helpful; and the latter did not reply. Other attempts were made, like writing to ASF – the Autoridade de Supervisão de Seguros e Fundos de Pensões.

The sparse information and literature available about this specific topic was a challenge and made it difficult study this theme with more depth.

Some useful information to this study was found. For instance, from Towers Watson which explains some accounting concepts and a comparison with FRS102; a paper from Groupe Consultatif Actuariel Europeen (2001) which gives an overview of actuarial work involved, such as methods and assumptions in retirement benefits across the European Union, and also covers the pension policy development in Europe.

Besides, an amendment of GASB Statement No. 27 from Ernest & Young which discusses the requirements of the Accounting and Financial Reporting for pensions by the Board.

Moreover, the institute of internal auditors published a paper comparing the last pension accounting, GASB 67, with previous ones.

Despite the lack of information, we decided to proceed with a case study of pension funds and compare, between 2013 and 2015, the evolution of the liabilities with the value achieved when performing the roll forward according the most used international rules, IAS 19 and FAS, for European Union and United States, respectively.

As a starting point, a full actuarial valuation was performed regarding figures from the end of the year 2013, 2014 and 2015 figures, then we took the valuation date of the end of the year 2013 and roll forward the liabilities to the measurement date of the end of the year 2014 and 2015 and compare the results. After that, some corrections were made to the formula in order to fine-tune the results given, increasing reliability and to get a close approximation to the real liabilities. The final goal is to take some conclusions regarding the accuracy of using the roll forward model for accounting purposes instead of a full valuation of the liabilities. If accuracy could be established considering a roll forward method, this could help large companies with the task of evaluating pension liabilities, since the real evaluations could be performed in larger intervals of three years.

Currently, the companies across the world are accounting the liabilities related with the benefits provided to their employees, including:

- Short-term benefits provided to their employees, such as salaries and social security contributions, pay on annual leave and on sick leave;
- Non-monetary benefits such as medical care, housing, cars and free or subsidised goods or services;
- Termination benefits and long-term employee benefits, including long-service leave or sabbatical leave, jubilee or other long service benefits, long-term disability benefits and, if they are not outstanding during a year

after the end of the placement, profit-sharing, bonuses and deferred compensation;

- Post-employment benefits like pensions, other retirement benefits, post-employment life insurance and post-employment medical care; Post-employment benefits are employee benefits (aside from termination benefits) which are due after the end of the employment contract.

On one hand, the scope of this work is only concerning post-employment benefits which are due to the employees after the end of the employment contract.

The roll forward method is acceptable as an alternative to a full valuation of the pension's liabilities, for periods no greater than three years, according to some accounting rules as, for instance the US GAAP.

Nevertheless, The European Union follows the regulations IASB settled by the International Accounting Standards Board (IAS 19), where they issued a revised version of IAS 19 employee benefits (revised IAS 19R) in June 2011 which was adopted in the EU by Regulation (EU) No 475/ 2012 on 5 June 2012. And, according to the revised IAS 19R "For practical reasons, an entity may request a qualified actuary to carry out a detailed valuation of the obligation before the end of the reporting period. Nevertheless, the results of that valuation are updated for any material transactions and other material changes in circumstances (including changes in market prices and interest rates) up to the end of the reporting period."

On the other hand, another practical use of a roll forward valuation, besides the possibility to skip some valuation dates for accounting purposes, is as a way of predicting the evolution of the liabilities in two or three years' time that can be useful for example for risk analysis.

1.2 Project Outline

This diploma project starts with a background in Chapter 2, by outlining general considerations about pension plans and pension funds, followed by two sections, Chapter 3, 3.1 and 3.2, covering recognition and measurement of defined benefit plans and the valuation date, according to accounting standards. In Chapter 4 essential concepts are presented regarding an actuarial valuation.

Following, in chapter 5 and 6, two results are reached, the first one is an actuarial valuation and the second one applies the roll forward method, based on a standard formula. Then, several suggestions of improvement are taken into

consideration regarding future evolution of the interest rate, as a way of improve the accuracy of the roll forward method.

Finally, project conclusions and final thoughts on future work are presented in Chapter 7.

Chapter 2

Background

2.1 Pension Plans

Pension plans are schemes where the rules for getting early retirement, retirement age, disability or death benefits are established. The pension plans are commonly employer sponsored plans, settled down to provide employees with retirement income.

The two biggest categories of employer sponsored pension plans are Defined Contribution (DC) and Defined Benefit (DB).

Defined benefit is a pension plan that specifies the pension promise to an employee at retirement, according to a given formula. Generally, the benefit is calculated based on years of service, salary and a multiplier factor, which varies by each plan.

Defined Contribution is a pension plan that specifies the contributions that will occur to be accumulated in employee's individual account.

For accounting purposes defined contribution pension plans have a linear treatment since the cost of benefits that will be provided after retirements are easy allocated to the years of service when those benefits are accrued.

However, in defined benefit pension plans the costs of the benefits provided after retirement require an actuarial valuation. The costs should be divided into different items: net interest on the net defined benefit liabilities, service cost and premeasurements of the defined benefit liability. The first two should be accounted in Profit and Losses (P&L) and the last one in Other Comprehensive Income (OCI).

The actuary tracks the pension plan funding on a regular basis, to assess whether the contributions need to be changed.

2.2 Pension Funds Accounting

The most usual way of funding post-retirement benefits, such as, pensions on well developed countries is through pension funds. Pension funds are assets that aim to fund one or more pension plans to their participants.

In DB pension plans, actuarial work is required for calculating the level of contributions that should be paid to the fund and the value of the liabilities; contributions are usually paid by the employer, although they can also be paid by the employee.

The pension plans liabilities are accounted according to the standards applied in each country, although many countries use or are converging on the International Financial Reporting Standards (IFRS) that were established and are maintained by the International Accounting Standards Board.

In some countries, local accounting rules are applied for regular companies but the majority of the companies should be conforming to IFRS, so statutory reporting can be compared internationally. Some of local applicable principles are for instance: the Generally Accepted Accounting Principles for US and for Canada (US GAAP and Canada GAAP), and the Generally Accepted Accounting Practice (UK GAAP) for UK.

The IFRS are seen as a standard for being willing to be applied on abroad consistent basis, across developed, emerging and developing economies.

For accounting pensions and other forms of post-employment benefits, according with the IFRS, the International Accounting Standard - IAS19 must be applied. The IAS19, and more recently its revised version, IAS19-R had influence on how the accounting standards have been developed in each specific country and as a consequence over the last decade has gained more importance not only across Europe but also in United States by companies which report their pension costs.

Table 2.1 shows the differences between the two accounting standards. On the one hand the frequency measure required by IAS19 is an annual reporting and on the other hand US GAAP only requires a triennially actuarial valuation. This shows that in US GAAP allows the use of roll forward. The Projected Unit Credit method used in this work is also permitted by both of them.

Table 2.1 Pension Accounting Standards

Source: PwC 2015, IFRS and US GAAP similarities and differences

	US GAAP	IFRS
Actuarial method used for defined benefit plans	Different methods are required depending on the characteristics of the plan's benefit formula.	PUC method is required in all cases.
Calculation of the expected return on plan assets	Based on either the fair value of plan assets or a "calculated value" that smoothes the effect of short-term market fluctuations over five years.	Limited to the "net interest" on the net defined benefit liability (asset) calculated using the benefit obligation's discount rate.
Treatment of actuarial gains and losses in net income	May be recognized in net income as they occur or deferred through a corridor approach.	Must be recognized immediately in other comprehensive income. Gains and losses are not subsequently recognized in net income.
Recognition of prior service costs from plan amendments	Initially deferred in other comprehensive income and subsequently recognized in net income over the average remaining service period of active employees or, when all or almost all participants are inactive, over the average remaining life expectancy of those participants.	Immediate recognition in net income for vested and unvested benefits.
Settlements and curtailments	Settlement gain or loss is recognized when the obligation is settled. Curtailment losses are recognized when the curtailment gains are recognized when the curtailment occurs.	Gain or loss from settlement is a recognized when it occurs. Change in the defined benefit obligation from a curtailment is recognized at the earlier of when it occurs or when related restructuring costs or termination benefits are recognized.
Multi-employer pension plans	Accounted for similar to a defined contribution plan.	Plan is accounted for as either a defined contribution or defined benefit plan based on the terms (contractual and constructive) of the plan. If a defined benefit plan, must account for the proportionate share of the plan similar to any other defined benefit plan unless sufficient information is not available.

Chapter 3

Defined benefit plans according to accounting rules

3.1 Recognition and Measurement

For defined benefit plans accounting involves actuarial methods to estimate the amount of benefit that employees have earned in exchange of their work in the current and prior periods. This depends on how the organization calculates the benefit assigned to the current and prior periods and their estimates (actuarial assumptions) about demographic variables (for instance, employee turnover and mortality) and financial variables (as salary increases and medical costs) that will affect the cost of the benefit.

Those projections of benefit payments should be based on the agreements at measurement date, including not only the impact of projected salary shifts but also the years of service provided, if the pension formula is calculated using the working years. Nevertheless, after the retirement, the benefits should be projected also including the cost-of-living-adjustments (COLA). The projection of benefit payments are discounted with an interest rate which has in consideration the long-term expected rate of return on pension plan investments. If there are any profits or losses in the pension plans, employers are required to recognize it on their financial report that came from not only from the funding position of the plan but also due to the difference between the actuarial methods used for accounting purposes and those used for funding purposes.

In Europe the accounting for pension liabilities according to IAS19 should have into consideration the aspects below:

- Projected Unit Method for determining benefit liabilities;
- Assets should be valued with market values rather than smoothed values;

- Assumptions should have a best estimate for valuing the liability;
- Assumptions should include all factors that can affect the benefits that will be paid in future, such as: salary increase rate, future pension increases;
- Discount rate that reflects the market yields on long dated.

3.2 Valuation date according to accounting rules

For accounting purposes, we need the critical dates regarding the actuarial valuation defined as follows:

- Valuation Date is the period for which the actuarial valuation is done;
- Measurement Date is the date when net pension liability is determined, generally it represents the end of the plan's fiscal year;
- Reporting Date is the final date when the plan's and/ or the employer's fiscal year ends.

An actuarial valuation is performed by taking a snapshot of the pension plan's membership and benefit provisions regarding the valuation date. Using this information as well as the actuarial assumptions for the valuation, the actuary calculates the total pension liabilities and other linked information. To estimate the total pension liabilities at a point in time following the valuation date, the actuary can use the roll-forward guidelines to project the total pension liabilities from the valuation date to a future date.

The possibility to use the roll-forward depends on the specific accounting standards applicable in each country.

On one hand, in Europe the rules for accounting pension benefits follows the revised IAS 19 which does not state any reference regarding the possibility of using the roll-forward although it allows that "For practical reasons, an entity may request a qualified actuary to carry out a detailed valuation of the obligation before the end of the reporting period. Nevertheless, the results of that valuation are updated for any material transactions and other material changes in circumstances (including changes in market prices and interest rates) up to the end of the reporting period." quote from the IAS19R paragraph 59.

On the other hand, in the United States, for accounting benefits of public employee retirement systems, the GASB statement N^{er} 67 is considered, which approves the use of the roll forward method instead of an actuarial valuation.

For GASB 67, the projection according to the roll-forward can be performed projecting the Total Pension Liabilities (TPL) from the valuation date to the measurement date (i.e., the plan's fiscal year-end), if needed. We have to take into consideration, that while the TPL may be based on an actuarial valuation up to 24 months earlier, the fiduciary net position (pension fund value) must always be the actual market value as the measurement date.

GASB 68, also applicable in the United States, outlines accounting rules for employers (whereas GASB 67 applies to the plans themselves). Under GASB 68, the reporting date for an employer must be equal to the employer's fiscal year-end. However, in contrast to GASB 67 (where the plan's measurement date must be the same as the plan's reporting date), GASB 68 allows a measurement date for employers that is no earlier than the employer's prior fiscal year-end, i.e., up to one year before the employer's fiscal year-end. If using a roll-forward method, the actuarial valuation date can be up to 30 months and one day earlier than the employer's fiscal year-end. Moreover, significant changes that happen prior to the measurement date shall be reflected. The importance of this provision of GASB 68 is that, even though multiple employers have different fiscal year-ends taking part in a plan, they may all use the TPL reported as of the plan's latest measurement date, provided that the TPL of the actuarial valuation at hand is in line to the timing requisitions of GASB 68.

Figure 3.1 Summary of timing options for public employee retirement system

Source: PERiScope 2014, GASB 67/68: Relationship between valuation date, measurement date, and reporting date (FYE: Fiscal Year Ending)
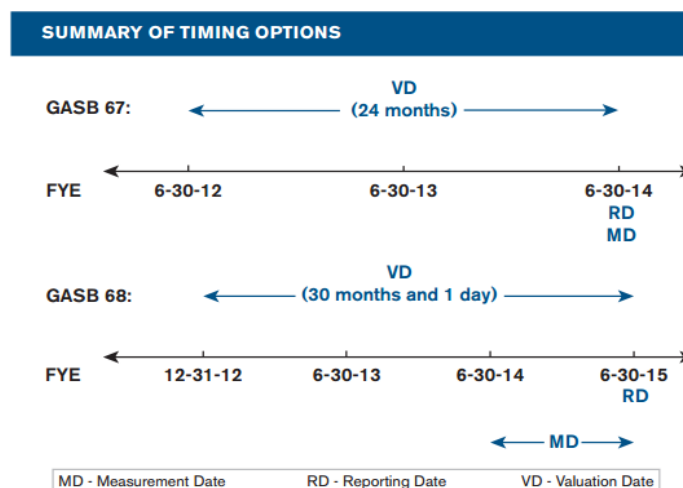
ASC 715 Compensation—Retirement Benefits applied in the USA to all entities and many types of compensation arrangements including any arrangement that is in substance a post-retirement benefit plan (regardless of its form or means or timing of funding), written and unwritten plans, deferred compensation contracts with individuals which taken together are the equivalent of a plan, and health and other welfare benefits for employees on disability retirement.

According to ASC 715, the measurements of benefit obligations should be the date of the employer's fiscal year-end statement of financial position except in both of the following cases:

- The plan is sponsored by a subsidiary that is consolidated using a fiscal period that differs from its parent's;
- The plan is sponsored by an investee that is accounted for using the equity method of accounting, using financial statements of the investee for a fiscal period that is different from the investor's.

In Canada, CPA Canada the section 3462 says that an actuarial valuation must be obtained at least every three years, but may occur more frequently and that in the years between valuations, the entity estimates the defined benefit obligation by performing a roll-forward technique.

From the research performed it seems clear that the use of roll-forward for accounting purposes is still applicable to certain specific situations.

The goal of this study is to determine how precise the roll-forward method can be and to measure the difference between the roll forward method and an actuarial valuation for accounting the liabilities.

Chapter 4

Some Concepts about Actuarial Valuation

4.1 Funding Method

Funding method usually refers to the calculations of the amount of contributions and when they should be made towards the cost of giving retirement benefits.

As mentioned previously, according to IAS 19 the actuarial valuation needs to be performed with PUC method, PUC stands for Project Unit Credit. The PUC method considers the pensionable salary projected to the retirement age and depends on the years of service of the participant at the assumed retirement age.

In case of PUC method, the normal funding is equal to the Projected Benefits Obligation, PBO. The Normal Funding for one participant with age x is given as follows:

$$NF_x^r = PBO_x^r = PVB_x^r \ \frac{x-a}{RA-a} = PVB_x^r \ \frac{ps}{ts} \tag{4.1}$$

- NF_x^r corresponds to the proportion of liability granted due to the years of past service $(x - a)$, where x represents the actual age and a represents the entrance age, or $ps = x - a$, the total years of service at retirement age (RA), or, $ts = RA - a$;
- PVB_x^r stands for Present Value of Benefits, which corresponds to the liabilities of the future benefit payments and expenses.

For a participant with age x, that is still working in the company, PVB_x^r can be calculated as follows:

$$PVB_x^r = B_x^r \frac{l_{RA}}{l_x} v_i^{RA-x} \ddot{a}_{RA} \qquad (4.2)$$

Where, $\frac{l_{RA}}{l_x}$ is the probability of the member surviving from age x until the retirement age, B_x^r is the annual expected value of the pension at age x , of the age retirement pension, $v_i^{RA-x} = (\frac{1}{1+i})^{RA-x}$ is the discounting factor from the retirement age (RA) to the age x, with an annual interest rate i , and $\ddot{a}_{RA}$ is the value of the annuity-due at retirement age.

For a pensioner, the PVB_x^r is the present value of the benefits that are in payment times the annuity at the age x of the pensioner.

$$PVB_x^r = B_x^r \ddot{a}_x \qquad (4.3)$$

According to PUC we have $NF_x^r = PBO_x^r = PVB_x^r$ for each pensioner, since no additional years of service will be granted in the future.

The value of liabilities that should be considered under the accounting rules correspond to the sum of all the individuals Projected Benefits Obligation, computed for each active and pensioner participant.

The net defined benefit liabilities will correspond to the difference between the Projected Benefit Obligation and the fund value at valuation date.

According with Section 3642 applicable in Canada the PUC is also the required funding method whenever the benefits depend on future salary levels or cost escalation affect the amount of the employee future benefits.

4.2 Service Cost according to IAS 19

According to IAS 19, the service cost includes: current service costs, past service costs and gains or losses on non-routine settlements and the timing recognition. The IASB defines current service cost as the increase in the present value of the defined benefit obligation resulting from employee working in the current period.

Considering, for the Projected Unit Credit Method the formula of the service cost will be:

$$SC_t = NC_t(1 + i) \qquad (4.4)$$

Where, NC_t, stands for Normal Cost during the year t and is calculated as follows:

$$NC_t = \frac{PVB_t}{ts} \qquad (4.5)$$

As stated in IAS19, the interest cost should be calculated by multiplying the net defined benefit liability (asset) by the discount rate, both as calculated at the beginning of the annual reporting date, taking into account the contribution and benefit payments:

$$IC_t = PBO_{t-1}\, i - EBP_t\, \frac{i}{2} \qquad (4.6)$$

Where, i is the discount rate; EBP_t stands for Expected Benefit Payments during the year t. Although, some companies consider the interest on NC_t as part of Interest Cost and in that case the normal cost became equals to service cost and the interest cost is given as follows:

$$IC = PBO_{t-1}\, i - EBP\frac{i}{2} + NC\, i \qquad (4.7)$$

Table 4.1 Components of defined benefit cost

Source: IAS 19 (2011).120-130

Component	Recognition
Service cost attributable to the current and past periods	Profit or loss
Net interest on the net defined benefit liability or asset, determined using the discount rate at the beginning of the period	Profit or loss
Premeasurements of the net defined benefit liability or asset, comprising: - actuarial gains and losses - return on plan assets gains and losses - some changes in the effect of the asset ceiling	Other comprehensive income (Not reclassified to profit or loss in a subsequent period)

4.3 Premeasurements of the defined benefit liability (asset)

The differences between actual experience and previous assumptions that may occur, that growth or reduce the expected liabilities, together with the effects of shifts of one or several valuation assumptions, will be recognized in other comprehensive income, as premeasurements of the net defined benefit liability (asset).

So a premeasurement is known by all gains or losses on the plan's assets and liabilities. Premeasurement can be for instance, any effect on the plan's defined benefit obligation of changes in actuarial assumptions or, due to actual experience diverging from those assumptions.

Usually premeasurement that occur on the liability side are referred to as actuarial gains and losses, and those that occur on the fund (asset) side are referred to as financial gains and losses.

"Gains or losses on the settlement of a defined benefit plan are recognized when the settlement occurs." According to IAS 19(2011) paragraph110

"Before past service costs are determined, or a gain or loss on settlement is recognized, the net defined benefit liability or asset is required to be premeasured, however an entity is not required to distinguish between past service costs resulting from curtailments and gains and losses on settlement

where these transactions occur together." According IAS 19(2011). Paragraph 99-100

4.4 Evolution of Liabilities values considering the accounting items

Considering the accounting rules, the evolution of the liabilities from the beginning of the year until the end of the year can be computed according to the following formula:

$$PBO_t = PBO_{t-1} + IC_t + SC_t - EBP_t + G\&L_t \qquad (4.8)$$

G&L are the actuarial Gains & Losses, EBP_t stands for expected benefit payments during the year, IC_t stands for Interest Cost, represents how much the liabilities should increase to reflect the interest rate, SC_t stands for Service Cost, it's the amount of liabilities that corresponds to the worker service subject to the year in study, t is the year of valuation and PBO_t stands for Projected Benefit Obligations.

So, according to this formula the PBO at the end of a given year can be calculated recursively considering the PBO value at the beginner of the year, and this is the equation considered for roll forward purposes.

The expected value of G&L will be zero if PBO_t results from a roll forward and not a full valuation because usually when performing the roll forward it is assumed that everything will occur as expected.

4.5 Roll Forward

Roll forward is an allowed method of accounting liabilities during a whole year, according to accounting standards, as mentioned before. In addition, the evaluations according to the roll forward may be useful to validate historical financial information and to project the future financial level of an organization.

We can perform roll forward or an actuarial valuation depending on the date of the actuarial valuation and when we want the reporting date.

Depending on the applicable accounting standard, the roll forward can be applied to a limit of three consecutive years avoiding the need of performing an actuarial valuation.

To perform the roll forward, the latest data available is considered, i.e., if we have the last actuarial valuation on 01/ 01/ 2013 and we would like to roll forward to, 2014 and 2015 we will use the data available in 2013. Also, it is possible to use the roll forward if we have the actuarial valuation at the beginning of the year, for instance, at 01/ 01/ 2013 and we want the accounting report at 01/ 06/ 2013, we can roll forward the liabilities six months from the actuarial valuation. To roll-forward liabilities, estimates should be made of the current service cost of the fund, the expected benefit payments or the real ones if there are already known and the interest gathered on the liabilities.

To roll forward the liabilities a whole year, the standard formula is given, as follows:

$$PBO_t = PBO_{t-1} + IC_t + SC_t - EBP_t \qquad (4.9)$$

Where SC_t stands for service cost during the year t; NC_t is the normal cost during year t. The normal cost is the cost attributed to the current year of service. IC_t stands for interest cost during the year t.

Roll forward can also be written within n months and considering simple interest rate, which becomes:

$$PBO_t = PBO_{t-1} + IC_t \times \frac{n}{12} + SC_t \times \frac{n}{12} - EBP_t \qquad (4.10)$$

Where $t = t - 1 + n$ and EBP_t is the expected benefits payment during the n months following t-1.

However, the formula 4.9 has some issues, namely, it does not have in consideration the impact of a change in the assumptions and movements on the population used.

Regarding the contributions, we should have the same notes as in actuarial valuations. They can be paid at the beginning, middle or end of the year. If no information is available regarding the moment when the contribution is performed usually it is assumed that contributions are paid in the beginning of the year.

Also, the expected benefit payments (EBP) are usually paid every month, for simplicity it is assumed a single annual payment that occurs at the middle of the year. It is also assumed that the interest cost for pensions is already included in EBP.

If other payments are due by the Fund, then they should be considered for roll forward purposes, (examples include: insurance premiums, transfers, among others).

Chapter 5

Case Study: Pension Fund Characteristics, assumptions, data and liabilities

For this case study we have used a pension fund managed by the company where I am working at the moment.

The pension plan is a defined benefit, with an accrued rate of 4% per year of service of the last annual pensionable wage.

Formula 5.1 shows the pension for a participant of the fund at the age of the retirement benefit:

$$B_{ARA}^{r} = 4\% \times ts \times W_{ARA} \tag{5.1}$$

Where W_{ARA} is the estimated annual wage at retirement age projected by the annual salary increase rate to the assumed retirement age, 65, and *ts* are the years of service continuing from the hire date until retirement age (65 years old).

The valuation dates were computed at the end of the fiscal year: 31/12/2013, 31/12/2014 and 31/12/2015. The population under the pension plan is given each fiscal year end for performing an actuarial valuation and is composed by actives and pensioner participants. The financial and demographic assumptions are given *a priori*.

5.1 Assumptions

The assumptions presented at this project can be divided into two stages. In a first step, an actuarial valuation was performed given assumptions based on market conditions at 31/12/2013 to compare the unrealistic results with the standard formula of roll forward. And in a second stage the real assumption, reflecting the changes occurred in the market conditions, for years 2014 and 2015 were considering, and the roll forward formula adjusted to reflect this changes.

Table 5.1 shows the real assumptions observed, where a marked decrease of 159 basis points on the discount rate for 2014, and of 30 basis points for 2015 can be observed This changes, special the one occurred during the year 2014, has a huge impact on the valuation.

Table 5.1 Real assumptions

Actuarial Assumptions	31/12/2013	31/12/2014	31/12/2015
Discount Rate pre-retirement (%)	3.89	2.30	2.00
Discount Rate post-retirement (%)	3.89	2.30	2.00
Mortality Table	TV 88/ 90	TV 88/ 90	TV 88/ 90
Salary increase rate (%)	2.50	2.50	2.50
Pension increase rate (%)	1.50	1.50	1.50

As required by the IAS19 rules the rate used to discount post-employment benefit obligations were determined by reference to the market yields at the end of the reporting period on high quality corporate bonds, and during this period the changes occurred were significant. The other assumptions, namely mortality table, annual salary increases and pension increases remained unchanged during the period 2013-2015.

5.2 Population

For this case study we used real participant data composed by active and pensioner participants. It is a small population, with a total of 187 participants in 2013. The statistics are divided into groups of participants. Table 5.2 shows the number of active participants split by actives below 63 years old, actives with 63 years old and actives with age greater than 63 years old. Table 5.3 shows the number of beneficiaries from 2013 to 2015:

Table 5.2 Active Participants statistics

Actives	31/12/2013	31/12/2014	31/12/2015
Number of actives	107	104	101
Lower than 63 years old	105	99	91
Equal to 63 years old	0	4	5
Greater than or equal to 64 years old	2	1	5
Total Pensionable salary (€)	5,620,573.99	5,650,316.41	5,653,113.75
Average Pensionable salary (€)	52,528.73	54,329.97	55,971.42
Average age	49.07	49.84	50.73
Average past service	20.52	21.38	22.24

The number of active members decreased over this time period.

In 2013, we have 107 active participants with an average age of 49.07 years old, which climbed to 104 active participants in 2014, with an average age of 49.84 years old. In 2015, we also verify a decrease to 101 active participants with an average age of 50.73 years old. The salaries show similar trends: first increase 0.53% from 2013 to 2014 and during 2015 we see an increase of the salaries in 0.05%.

Table 5.3 Beneficiaries statistics

Pensioners and Beneficiaries	31/12/2013	31/12/2014	31/12/2015
Number of pensioners and beneficiaries	87	88	87
Total value of benefits (€)	772,091.16	791,818.80	800,314.31
Average age of pensioners and beneficiaries	72.55	73.47	74.25

To sum up, we are dealing with an ageing population. In 2013 there are 87 pensioners, which represent 45% of our population in study with an average age of 72.55 years. The number of pensioners increased to 88 in 2014 and decreased again to 87 pensioners for 2015, with an average age 73.47 and 74.25 years old, respectively.

Table below summarizes the population changes occurred:

Table 5.4 Populations changes occurred

Reconciliation	31/12/2014	31/12/2015
New hires	1	0
Number of actives that during the year left the company, for other reason than retirement	3	3
Number of actives who got the retirement age	1	0

During the year 2014 we record that 1 active participant became pensioner of the fund and the other 3 leave the company and we have one new hire.

During the year 2015, the fund recorded 3 active participants exit and 1 pensioner has died.

5.3 Results

The aim is to compare the results achieved with the results computed when considering the roll forward method. In a first analysis we performed an actuarial valuation with assumptions at 31/12/2013, stated in table 5.1.

Table 5.5 depicts the full annual liabilities obtained with the method covered in Chapter 4 from 2013 to 2015.

Table 5.5 Results of Actuarial Valuations with assumptions of 2013

Liabilities	31/12/2013	31/12/2014	31/12/2015
Present Value of Benefits for Actives (€)	8,479,152.66	8,618,697.41	8,749,924.54
Projected Benefit Obligation for Actives (€)	5,124,337.97	5,366,478.30	5,665,474.01
Interest Cost for Actives (€)	199,101.12	208,624.50	220,254.79
Current Service Cost (€)	242,428.27	248,299.45	255,183.89
Projected Benefit Obligation for Pensioners (€)	8,977,521.15	8,876,884.72	8,586,676.45
Pensions in Payment (€)	772,091.16	791,819.26	800,314.77
Interest Cost for Pensioners (€)	334,208.40	329,909.93	318,455.59

Thus we can see that the PBO_{2014} had a considerable increase of 5% for actives from (PBO_{2013} = 5,124,337.97€ to PBO_{2014}= 5,366,478.30). The PBO_{2014} for pensioners is relatively high, starting at 8,977,521.15 € observing a decrease of 1%, to 8,876,884.72€ in 2014.

During 2015, PBO_{2015} had a little increase of 1% for active participants, PBO_{2015}= 5,665,474.01€ and a decrease of 3% for pensioners, PBO_{2015}= 8,586,676.45€.

The current service cost it is the actuarial present value of the benefits vested to the services accomplished by participants during each year of work. For 2013 we have a CSC = 242,428.27€, for 2014 CSC = 248,299.45€ and for 2015 we have a CSC= 255,183.89€.

Table 5.6 depicts the results from a full actuarial valuation with the same approach as stated in Chapter 4, divided by group of participants. The values are computed using the real assumptions stated in table 5.2.

Table 5.6 Results of Actuarial Valuations with real assumptions

Liabilities	31/12/2013	31/12/2014	31/12/2015
Present Value of Benefits for Actives (€)	8,479,152.66	12,483,541.71	13,412,169.08
Projected Benefit Obligation for Actives (€)	5,124,337.97	7,542,036.80	8,370,423.40
Interest Cost for Actives (€)	199,101.12	173,389.09	167,340.52
Current Service Cost (€)	242,428.27	351,458.49	379,695.82
Projected Benefit Obligation for Pensioners (€)	8,977,521.15	10,044,625.95	9,901,427.06
Pensions in Payment (€)	772,091.16	791,819.26	800,314.31
Interest Cost for Pensioners (€)	334,208.40	221,920.48	190,025.39

The PBO_{2014} for actives increased 47%, when we compare with 2013 figures, due to the significantly change on discount rate. On the other hand, the PBO_{2014} for pensioners increased 12%. The difference in both impacts is due to the stream of cash flows. For 2015 we can observe that the PBO_{2015} had the expected change, an increase of 7% for active participants. In contrast, it is important to note that the PBO_{2015} for pensioners decreased 1%. This difference is due to the loss mortality and the pensions did not increase as expected so they not compensate the decrease of the discount rate.

The interest cost for 2014 decreased 13% for actives and 34% for pensioners. For 2015, the interest cost decreased 3% for actives and 14% for pensioners.

The current service cost increases along the time, in 2014 we can see an increase of 45% and an increase of 8% for 2015.

5.4 Sensitivity Analysis

Sensitivity testing is the most common method to calculate the risk of interest rate. We will use an effect of 25 basis points upward and 25 basis points downward change in the yield curve on the value of liabilities. Nevertheless, other changes can be considered in the assumptions such as, salary increase rate, mortality tables, pension increase rate, among others. In our case study those sensitivities were not useful because we already knew in first place that those assumptions would be constant along time.

Those sensitivity scenarios are usually performed easily during the actuarial valuation, changing the assumptions in the actuarial model.

In the table below we present the results of the discount rate sensitivity test, considering an impact of +/-25 basis points on 2013 with a base scenario of 3.89%:

Table 5.7 Results of interest rate sensitivity analysis, at 31/12/2013

Liabilities	i – 25b.p.	base	i + 25b.p
Present Value of Benefits for Actives (€)	8,983,577.10	8,479,152.66	8,009,276.87
Projected Benefit Obligation for Actives (€)	5,400,107.65	5,124,337.97	4,866,231.79
Interest Cost for Actives (€)	196,343.44	199,101.12	201,211.23
Current Service Cost (€)	256,053.33	242,428.27	229,696.81
Projected Benefit Obligation for Pensioners (€)	9,151,647.79	8,977,521.15	8,809,387.81
Pensions in Payment (€)	772,091.16	772,091.16	772,091.16
Interest Cost for Pensioners (€)	319,067.92	334,208.40	348,726.37

The impact on liabilities when we change the interest rate, was as we were expecting. When we have a decrease on interest rate, we observe an increase on liabilities and vice-versa.

When we have an interest rate of 3.64% we have an increase on PBO and PVB on both group of participants; more specifically, an increase of 6% for active participants and an increase of 2% for pensioner participants. For interest cost we have a decrease of 1% for actives and a decrease of 5% for pensioners. The service cost also increased 6%.

On the other hand, when we have an interest rate of 4.14%, the PBO and PVB decrease by 5% and 6% respectively for active participants and a decrease by 2% for pensioners. The interest cost for actives is increased by 1% and 4% for pensioners. The service cost decreases by 5%.

Chapter 6

Roll forward accuracy for the case study

Regarding the table 5.2 we can see that the discount rate is lower than in 2013 so it only makes sense to apply the roll forward adjusted to the realistic scenario. If the opposite happened, one should apply the same approach to the upward scenario, +25 basis points on the discount rate.

Since the real discount rate for 2014 is 2.30%, too lower when compared with the real discount rate from 2013, 3.89%, the calculations below are performed based on the downturn sensitivity scenario, -25 basis points on discount rate of 2013. This means that the starting point for the roll forward is a PBO with $i = 3.64\%$

6.1 Roll forward unadjusted

Table 6.1 depicts the liabilities with assumptions stated in table 5.2, applying formula 4.5 for 2014 and 2015.

Table 6.1 Roll forward with assumptions 31/12/2013

	2014 (€)		2015 (€)
PBO_{2013}	14,101,859.12	Roll Forward Unadjusted	14,108,169.27
Current Service Cost	247,701.37	Current Service Cost	248,299.45
Interest Cost	533,309.52	Interest Cost	538,534.43
Expected Benefit Payments	774,700.74	Expected Benefit Payments	797,861.45
Roll Forward Unadjusted	14,108,169.27	Roll Forward Unadjusted	14,097,141.70
Real PBO_t	14,243,363.02	Real PBO_t	14,252,150.46
Difference	0.96%	Difference	1.10%

In the table above, the PBO_{2013} was calculated with the actuarial valuation as covered in Chapter 4 and applied the standard formula, this gave a good approximation.

The roll forward for 2015 was calculated with the same formula 4.5. In general, it gives a good result.

6.2 Roll forward adjusted

In this chapter the adjusted roll forward is introduced. This roll forward is done in two steps. First of all, the roll forward considers the item gains and losses. After that, since the real discount rate is outside a sensitivity range considered, a roll forward with an adjustment based on sensitivity range adjusted to the impact of the real discount rate will be performed.

Table 6.3 depicts the roll forward method with gains and losses:

Table 6.2 Roll forward adjusted considering annual variations on wages, pensions and terminations

	2014 (€)		2015 (€)
PBO_{2013}	14,551,755.44	Roll Forward adjusted	14,349,326.90
Current Service Cost	247,701.37	Current Service Cost	248,299.45
Interest Cost	533,309.52	Interest Cost	538,534.43
Expected Benefit Payments	774,700.74	Expected Benefit Payments	797,861.45
Gains and Losses	241,157.63	Gains and Losses	2,385.30
Roll Forward adjusted	14,349,326.90	Roll Forward adjusted	14,335,914.04
Real PBO_t	14,243,363.02	Real PBO_t	14,252,150.46
Difference	-0.74%	Difference	-0.58%

In 2014 the discount rate decreased 1.59 basis points from 2013. According to the sensibility a downturn in discount rate of 25 basis points was considered, this implies an increase on liabilities of 3.19%, so the roll forward should be increased in 20.29%. Table 6.4 shows the liabilities considering this increment:

Table 6.3 Roll forward adjusted considering the change on discount rate assumption, due to market conditions

	31/12/2014 (€)
PBO_{2013} with $i = 3.89\%$	14,101,859.12
PBO_{2013} with $i = 3.64\%$	14,551,755.44
Impact on liabilities due to change the discount rate	3.19%
Current Service Cost	247,701.37
Interest Cost	533,309.52
Expected Benefit Payments	774,700.74
Gains and Losses	241,157.63
Roll Forward adjusted	14,349,326.90
Impact of the discount rate on sensitivity	20.29%
Roll Forward adjusted according the sensitivity	17,260,877.08
Real PBO_{2014}	17,568,191.43
Difference	1.78%

Introducing this increment good results are obtained. It gives a roll forward for 2014 of 17,260,877.08€, that gives a difference of 1.78% when it is compared with the real PBO_{2014}.

Table 6.4 Roll forward adjusted for 31/12/2015

	31/12/2015 (€)
Roll Forward adjusted	14,349,326.90.18
Current Service Cost	248,299.45
Interest Cost	538,534.43
Expected Benefit Payments	782,781.60
Roll Forward Unadjusted	14,338,299.34
Gains and Losses	2,385.30
Roll Forward adjusted	14,335,914.04
Impact of the discount rate on sensitivity	24.12%
Roll Forward adjusted according the sensitivity	17,793,581.79
Real PBO_{2015}	18,271,850.45
Difference	2.69%

Therefore, for both years 2014 and 2015 it can be observed looking at the tables above that the roll forward has a good approximation of the results without performing an actuarial valuation.

It is important to note that this can be applied in expected conditions, although the approximation can be controlled in advance, whenever a company has the real expectation about salary or pension growth, any participant movements, or any relevant information that should be considered in roll forward, because the accuracy is improved substantially.

Chapter 7

Conclusions

As the presented project was developed, I had the opportunity to improve my knowledge in the accounting of pension funds, in particular the importance of the roll forward.

The case study focused on real data from 2013 to 2015. It begins with the implementation of the actuarial valuation as explained on Chapter 3. My real data is composed by actives and pensioners, as referred in table 5.2, with average ages 49 and 73 years old, respectively.

The main purpose of this project is to understand the impact of performing a roll forward instead of doing the actuarial valuations from 2013 to 2015 according to IAS19 and their limitations.

For the period in study, from 2013 to 2015, we conclude that the roll-forward approximation of the liabilities values, after adjusting for some of the annual actuarial gains and losses that can be measured simply and for the change in assumptions, the liabilities approximation obtained was 1.78% lower than its real values for 2014, and 2.69% for 2015.

Considering the long term nature of the pension funds liabilities and the corresponding high level of uncertainty regarding the future evolution of the assumptions considered and the population data, we find the results achieved as acceptable values for skipping one or two years full valuations of the liabilities.

However, it is important to emphasize that roll-forward will accumulate deviations as the period considered increases thus it is not recommended for periods greater than two years.

In addition, in order to achieve good results, it will be important to have a well-behaved population in the sense that it should not face higher deviations from the expected pattern during the period that the liabilities are being rolled forward.

Also it is important to keep in mind that roll-forward method will flatten results during the period in which the liability are being rolled forward, but consequently

will increase the deviations in the years where a full valuation is carried out. Hence, the use of this method should be limited to situations in which the full valuation of liabilities is significantly difficult either due to the complexity of the benefits being measured or due to the difficulty in consolidating and validating the necessary population data.

Hereupon, an interesting future study might be for instance, to understand if using the roll forward in a historical basis would help to adjust the assumptions to the reality and in that way contribute to obtaining better results.

Throughout this case study, it is possible to conclude that the roll forward method is a simple and approximate method to an actuarial valuation, has better conclusions for a short time frame, although as explained in section 6.2 it is possible to have good results with roll forward if the discount rate of the following year is known prior to the calculation. This is a way of predicting the liabilities in a global way reflecting the impact of changes on the discount rate.

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