UNIVERSITY OF LJUBLJANA
SCHOOL OF ECONOMICS AND BUSINESS

MASTER'S THESIS

A SENSITIVITY ANALYSIS ON DEFINED BENEFIT OBLIGATION UNDER IAS 19 IN SWITZERLAND

Ljubljana, September 2019 MIRJAM PERGAR

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LIST OF ABBREVIATIONS

AHV – Swiss Federal Old-Age and Survivors' Insurance

bp – Basis point

BVG – Swiss Federal Law on Occupational Retirement, Survivors' and Disability Pension Plans

CMI – Continuous Mortality Improvement

DBO – Defined benefit obligation

eng. - English

EY – Ernst & Young Ltd.

ger. – German

HQCB – High-quality corporate bonds

IAS 19 – International Accounting Standard 19

IFRS – International Financial Reporting Standards

IV – Swiss Federal Disability Insurance

LTR – Long-term rate of mortality improvement

n.d. – No date

PUC – Projected unit credit

UVG – Swiss Federal Law on Accident Insurance

INTRODUCTION

The Master's thesis focuses on employee benefits and their accounting under the International Accounting Standard 19 Employee Benefits (hereafter: IAS 19). There exist different kinds of employee benefits under IAS 19, however, the Master's thesis concentrates only on post-employment benefits, which include pensions. The accounting for pensions is not an easy task as multiple factors need to be considered.

Companies that promise certain benefits to their employees for their service need to account for what the present value of these future benefits will be. This value is also called the defined benefit obligation (hereafter: DBO). As the present value cannot be calculated precisely due to the uncertainty of future events impacting the level of these benefits, companies need to make certain assumptions. These assumptions then influence the amount of the obligation that will be calculated. The assumptions that impact the obligation can be split up into two categories: demographic and financial assumptions.

Demographic changes pose major challenges for all industrialized countries, especially with respect to their retirement systems (Eling, 2013). As the population grows older, pensions must be paid out for a prolonged period. This affects companies as they have promised post-employment benefits to their employees. If they do not anticipate the demographic changes on time, they might underestimate the amount of benefits they will have to provide in the future and will not make enough provisions for them in the present.

Pensions are also susceptible to financial parameters such as the discount rate, inflation, salary increases, and others. Companies need to choose appropriate parameters for these factors to value their DBO. For example, by overestimating the discount rate, the company underestimates its obligation. That is why choosing an appropriate parameter value for each assumption is important.

Demographic and financial assumption together form the so-called actuarial assumptions. One goal of the Master's thesis is to explain these assumptions and why we need them when accounting for pension liabilities. Therefore, information about how the assumptions are derived and what affects them is described in the thesis, but also Swiss specific parameter values for assumptions are provided. For comparison, we also mentioned some Slovenian parameter values.

The main purpose of the Master's thesis is to examine how the DBO under IAS 19 changes when one parameter value of either a demographic or financial assumption changes. The thesis provides insight into which parameter value changes lead to bigger differences in the DBO and if that difference is in line with our expectations. For example, our expectation is that a higher discount rate value will reduce the entity's obligation and we predict that a higher salary increase rate value will increase the obligation.

The Master's thesis focuses on Switzerland, which has one of the most comprehensive occupational pension systems not only in Europe but in the world. The Melbourne Mercer Global Pension Index (2018) benchmarks and ranks global retirement income systems based on the adequacy of retirement income, long term sustainability of the retirement system, and integrity of the overall retirement system[1]. According to this index, Switzerland's retirement system is ranked 11th best in the world[2] and 6th best in Europe (ranked 1st were the Netherlands). Switzerland also has one of the most stable economies in the world so the trends it sets are worth studying.

According to the Schweizerische Bundeskanzlei (n.d.a) (eng. Swiss Chancellery), the Swiss retirement system is based on the three-pillar principle. While the Slovenian pension system is mostly a pay-as-you-go system, where the working generation is paying for the retired generation, in Switzerland the pension system is a mixture of the pay-as-you-go system and the capital-funded system. The mixture of both systems makes the pension system superior to other systems that rely on only one of the two systems because the different parts of the expected pension are not influenced by the same parameters as e.g. population, migration, mortality, inflation, and financial market developments (Kuhn, 2019).

The goal of the Master's thesis is to perform a series of sensitivity analyses for chosen actuarial assumptions to show how the DBO would be affected by the changes in parameter values.

A sensitivity analysis is carried out by varying one assumption's parameter value while holding the parameter values of all other assumptions constant (also known as ceteris paribus). The results from a sensitivity analysis display how considerable the impact on DBO could be when a parameter value changes. The goal is not to answer the question if the effect on DBO is good or bad, we are merely attempting to derive by what percentage the obligation may change. The results could, however, be used to determine if the increase or decrease of the DBO might have a material effect on the statement of financial position by bearing in mind company's Summary of Audit Differences (hereafter: SAD). SAD comprises of planning materiality, tolerable error and SAD nominal amount, but ultimately tells us if a certain misstatement would have a significant effect on financial statements.

The research methodology comprises a theoretical and an empirical part. The theoretical part consists of three parts. The first part describes the IAS 19 standard and the DBO. The second part describes the Swiss retirement system. The third part goes into details about actuarial assumptions. This part serves as a basis for understanding the empirical part.

The empirical part consists of two parts. The first part includes the descriptions of which assumptions were part of the analysis, which Swiss pension benefit plan was used, how the

[1] Melbourne Mercer Global Pension Index is calculated as a weighted average of three sub-indices. The weights used are 40% for adequacy, 35% for sustainability and 25% for integrity (Mercer, 2018).
[2] Among 34 pension systems considered.

sample of client data was selected, how the sensitivity analysis with the benefit valuation tool functions and how it was adapted to fit the specific Swiss pension benefit plan and the specified parameter values. The Swiss pension benefit plan, client data, and the benefit valuation tool were kindly provided by Ernst & Young Ltd. (hereafter: EY). The second part presents the results obtained from the sensitivity analyses and describes the impact of each assumption on the DBO.

The results from the empirical part answer the following research questions:

- How does the DBO change if we use a different parameter value for an actuarial assumption?
- Is the increase/decrease of the DBO in line with our expectations and predictions?
- Which assumptions have the largest effect on the DBO?

The Master's thesis is structured in six separate chapters. The first chapter gives detailed insight into how employee benefits are defined in the IAS 19 accounting standard. The second chapter describes the Swiss retirement system. The third chapter focuses on actuarial assumptions and their importance in pension accounting. The fourth chapter describes which actuarial assumptions were analysed, it describes the benefit pension plan used, the data and sample selection process, and the benefit valuation tool used to calculate the results. The fifth chapter displays the results from the empirical research and answers the research questions. The sixth and final chapter is the conclusion which summarizes our research.

1 EMPLOYEE BENEFITS UNDER INTERNATIONAL ACCOUNTING STANDARD 19

IAS 19 provides guidance for employee benefits accounting and disclosure. Employee benefits refer to all types of benefits a company offers its employees in return for their current or past service. The benefits are divided into four groups according to paragraph 5 of IAS 19:

- short-term employee benefits,
- post-employment benefits,
- termination benefits, and
- other long-term employee benefits.

The cost of providing these benefits must be recognized in the same period as when they are earned and not when they are actually paid out, which is not simple for some of the benefits, especially for post-employment benefits.

Napier (2009) noted that experts have been struggling for decades with the complexity of accounting for retirement benefits as they represent complex employer-employee agreements, which do not fit easily into standard accounting categories.

The history of IAS 19 began in April 1980, when the very first draft of accounting for retirement benefits was published. Only three years later, on January 1983, the first official version of IAS 19 was published, which was compulsory for companies to use from January 1, 1985, on (IAS Plus, n.d.). This version was oriented towards the recognition of costs in the income statement and allowed entities to decide for themselves if they would use the salary increase rate assumption when measuring costs or not. The use of salary increase approximation soon became a standard (Napier, 2009). This version of IAS 19 was in use until January 1, 1999. Paragraph 1 of IAS 19 has remained unchanged and requires that "entities must recognize:

- a liability when an employee has provided service in exchange for employee benefits to be paid in the future, and
- an expense when the entity consumes the economic benefit arising from service provided by an employee in exchange for employee benefits."

IAS 19 has been updated a couple of times since then, but the broader goal has remained unchanged. The general trend of the updates has been towards an accounting standard that reflects market conditions more closely (European Actuarial Consultative Group, 2001).

The version that is in use today received a special name: IAS 19 (2011 revised) or shortly IAS 19R (hereafter: IAS 19), which the Master's thesis will use. It has been in use since January 1, 2013, and was an important update to the standard, because it got rid of the so-called corridor method, which had quite an influence on companies' financial statements. With the elimination of the corridor method, all actuarial gains and losses must be recognized immediately through the other comprehensive income (Deloitte, 2010). Some other changes included: enhanced disclosures about defined benefit plans, modifications to the accounting for termination benefits, clarification of estimates of mortality rates, and clarification of tax and administration costs (IAS Plus, n.d.).

In the following subchapters, the most important definitions regarding employee benefits are presented in more detail. These definitions include the type of benefits, the type of post-employment benefit plans, and DBO.

1.1 Type of employee benefits

The IAS 19 standard recognizes four types of employee benefits: short-term employee benefits, post-employment benefits, termination benefits, and other long-term employee benefits (IAS 19, 2011, para. 5, 8).

Short-term employee benefits (other than termination benefits) are benefits that are expected to be settled within one year after the end of the annual reporting period in which the related service was provided. These benefits are wages, salaries and social security contributions,

absences (sick leave, vacation), bonuses, and non-monetary benefits (medical care, housing, cars, etc.) (IAS 19, 2011, para. 9).

Post-employment benefits (other than short-term and termination benefits) are employee benefits that are payable after the completion of employment. These are for example retirement benefits (pensions, lump sum payments) and other post-employment benefits (life insurance, medical care) (IAS 19, 2011, para. 26).

Termination benefits are benefits provided in exchange for the termination of an employee's employment because of either an entity's decision to terminate or an employee's decision to accept an offer of benefits in exchange for termination (IAS 19, 2011, para. 8). These are the only benefits that are provided in exchange for the termination of employment and not for the service (IAS 19, 2011, para. 159).

Lastly, long-term employee benefits include all other employee benefits that are not included in short-term employee benefits, post-employment benefits, and termination benefits. The benefits included in this type are long-term paid absences (sabbatical leave), jubilee benefits, and long-term disability benefits (IAS 19, 2011, para. 153).

In the Master's thesis, only post-employment benefits are considered as their accounting is the most difficult and involves actuarial assumptions.

1.2 Post-employment benefit plans

Post-employment benefit plans are arrangements under which an entity provides post-employment benefits (IAS 19, 2011, para. 8). They are classified as either defined contribution plans or defined benefit plans (IAS 19, 2011, para. 27). The accounting treatment for these two plans differs and therefore it is extremely important to classify post-employment benefits correctly.

1.2.1 Defined contribution plans

Defined contribution plans are as the name suggests post-employment benefit plans under which an entity pays fixed contributions into a fund. If the fund does not hold sufficient assets to pay all employee benefits, the entity will have no obligation to pay further contributions (IAS 19, 2011, para. 8). In other words, an entity's obligation is limited to the amount it agrees to contribute to the fund. Therefore, the amount of benefits an employee will receive is determined with the amount of contributions paid by an entity to the fund. In

consequence, actuarial risk[3] and investment risk[4] befall the employee and not the entity (IAS 19, 2011, para. 28).

For this reason, accounting for defined contribution plans is straightforward since the entity's obligation for each period is determined by the amount they contributed for that period. As no actuarial assumptions are needed to measure the obligation or the expense, there are no actuarial gains or losses. Furthermore, the obligations have to be discounted only if they are not settled within a year after the end of the annual reporting period (IAS 19, 2011, para. 50, 52).

1.2.2 Defined benefit plans

Under defined benefit plans it is the entity's obligation to provide agreed benefits to its current and former employees. In contrast to defined contribution plans, the actuarial and investment risks in this plan fall at least partially on the entity and not on the employees. "If actuarial or investment experience are worse than expected, the entity's obligation may increase" (IAS 19, 2011, para. 30).

Accounting for defined benefit plans is therefore not straightforward but rather complex since actuarial assumptions are required and actuarial gains and losses may arise. Besides, the obligations have to be discounted since they may be settled many years after the employees stop providing any service to the employer (IAS 19, 2011, para. 55). Even if part of the obligation is expected to be settled within a year, the entire obligation must be discounted (IAS 19, 2011, para. 69).

In the Master's thesis only defined benefit plans are analysed as all Swiss pension plans are considered as defined benefit plans from an IFRS perspective as per Art. 15 of the Swiss Federal Law on Vesting in Pension Plans (Die Bundesversammlung der Schweizerischen Eidgenossenschaft, 2017). The reasons for this are that the Swiss law has minimum guarantees on conversion rates and interest credit rates (see chapters 3.2.5 and 3.3.2, respectively), and an employer can be forced to pay extraordinary cash contributions in case of underfunding.

1.3 Defined benefit obligation

The most important value when dealing with post-employment benefits is the DBO as it represents the present value of benefits (such as pensions) that an entity promised its employees.

[3] Actuarial risk here means that benefits will be less than an employee expects (IAS 19, 2011, para. 28).
[4] Investment risk means that assests invested will be insufficient to meet expected benefits (IAS 19, 2011, para. 28).

"The present value of a DBO is the present value of expected future payments required to settle the entities obligation resulting from employee service" (IAS 19, 2011, para. 8). The present value of a DBO affects the statement of financial position, because the net amount recognized on it is, simply put, the difference between the DBO and the plan assets (IAS 19, 2011, para. 63). Plan assets are assets held by a fund that funds and pays out employee benefits.

More formally, the difference between the present value of DBO and the fair value of plan assets is called the net defined benefit liability/asset. If the present value of the DBO is bigger than plan assets, there exists a deficit, since there are more obligations than there are assets. On the other hand, if there are more plan assets, then we have a surplus. But in the latter case, the plan assets need to be adjusted for the effect of asset ceiling[5] (IAS 19, 2011, para. 64). If the DBO changes due to changes in actuarial assumptions, actuarial gains and losses arise.

The ending value for the reporting period's DBO is simply shown in Table 1.

Table 1: Determining the end value of a DBO

	DBO at the beginning of the period
+	service cost consisting of: • current service cost[6] • past service cost[7]
+	employee contributions
+	interest cost[8]
-	benefits paid
+/-	actuarial gains/losses due to: • demographic assumptions • financial assumptions • experience adjustments[9]
=	**DBO at the end of the period**

Adapted from Obaidullah (2018).

[5] "The asset ceiling is the present value of any economic benefits available in the form of refunds from the plan or reductions in future contributions to the plan" (IAS 19, 2011, para. 8).
[6] Current service cost is the increase in the present value of the DBO resulting from employee service in the current period (IAS 19, 2011, para. 8)
[7] "Past service cost is the change in the present value of the DBO for employee service in prior periods, resulting from either a plan amendment or a curtailment (a significant reduction by the entity in the number of employees covered by a plan)" (IAS 19, 2011, para. 102). May be positive or negative (IAS 19, 2011, para. 106).
[8] Interest cost is the change in the net defined benefit liability/asset due to the passage of time (IAS 19, 2011, para. 124).
[9] "Experience adjustments are the effects of differences between the previous actuarial assumptions and what has actually occurred" (IAS 19, 2011, para. 8).

Similarly, the ending value for plan assets is presented in Table 2.

Table 2: Determining the end value of plan assets

	plan assets at the beginning of the period
+	contributions made by the: • employer • employee
-	benefits paid
+	return on assets[10]
=	**plan assets at the end of the period**

Adapted from Obaidullah (2018).

1.3.1 Recognition

Some of the values we mentioned in chapter 1.3 must be recognized in the entity's financial statements and disclosed in the annual report.

In the statement of financial position, IAS 19 requires the entity to present the benefit obligation as a single amount, that is the net defined benefit liability/asset. It is recognized as a liability or an asset, depending on if there is a surplus or a deficit (IAS 19, 2011, para 63).

Defined benefit cost consists of service cost, net interest on the net defined benefit liability/asset (hereafter: net interest[11]), and of remeasurements of the net defined benefit liability/asset and has to be recognized (IAS 19, 2011, para. 120). Service cost and net interest are recognized in the statement of profit and loss as an expense (IAS 19, 2011, para. 57(c), 103). As seen in Table 1, service cost comprises of current and past service costs (where we also include the gain or loss on settlement[12]), while net interest encompasses interest cost[8] on the DBO, interest income on plan assets, and interest on the effect of the asset ceiling (IAS 19, 2011, para. 124).

Remeasurements of the net benefit liability/asset consist of recognizing actuarial gains/losses, return on plan assets, and any change in the effect of asset ceiling in other comprehensive income (IAS 19, 2011, para. 57(d)). Actuarial gains or losses resulting from, for example, changing the mortality table (demographic assumption) and changes in the

[10] The return on plan assets consists of interest, dividends, and other income derived from plan assets (such as gains and losses on the plan assets) (IAS 19, 2011, para. 8).
[11] Net interest is determined as the net defined benefit liability/asset multiplied by the discount rate assumption (IAS 19, 2011, para. 123).
[12] A settlement happens when an employee's benefit is paid out (wholly or partially), so the entity no longer has an obligation (IAS 19, 2011, para. 8). Gain or loss on settlement is the present value of the DBO being settled minus the settlement price (IAS 19, 2011, para. 109).

discount rate (financial assumption). The return on plan assets is recognized excluding interest income, which is the fair value of plan assets multiplied with the discount rate assumption (IAS 19, 2011, para. 125, 127(b)). The change in the effect of asset ceiling is recognized as well excluding the interest on the effect and determined as the effect of asset ceiling multiplied with the discount rate (IAS 19, 2011, para. 126, 127(c)). Once the remeasurements are recognized in other comprehensive income, the entity cannot recycle them to profit or loss in the following period, but they can be transferred to equity (IAS 19, 2011, para. 122).

1.3.2 Measurement

The ultimate cost of a defined benefit plan may be influenced by many variables, such as employee contributions, mortality, employee turnover, final salaries, and others. The end cost of the plan is, therefore "uncertain and this uncertainty is likely to persist over a long period of time" (IAS 19, 2011, para. 66). To measure the present value of the post-employment benefit obligations, it is necessary to use an actuarial technique, to attribute benefit to periods of service and to make actuarial assumptions (IAS 19, 2011, para. 66(a)-(c)).

To determine the present value of the DBO (and related service costs) a method called the projected unit credit method (hereafter: PUC method) must be used (IAS 19, 2011, para. 67). The PUC method is sometimes also known as the "accrued benefit method pro-rated on service" or as the "benefit/years of service method". The aim of the PUC method is to value accrued benefits by looking at their projected amount at the time of payment (European Actuarial Consultative Group, 2001). Each period of service earns an employee an additional unit of benefit. Each unit earned must be projected over current and prior periods to determine the DBO (IAS 19, 2011, para. 68). By using this actuarial technique an entity can "measure the obligation with sufficient reliability to justify recognition of a liability" (IAS 19, 2011, para. 71).

Using the PUC method, the DBO is calculated as in formula (1) (Bayerische Pensions Service GmbH).

$$DBO = L \cdot p \cdot \frac{1}{(1+i)^n} \cdot \frac{(x-a)}{(b-a)} \quad (1)$$

With:

L:	benefit amount (e.g. retirement savings)
p:	probability of benefit payment to occur (e.g. disability probability, turnover probability)
i:	discount rate
x:	current age
a:	entry age

b: age at benefit payment
n: years left until benefit payment (*b-x*)

Promised benefits are dependent on employee's future employment i.e. the benefits are not vested. Employee service is, therefore, a constructive obligation[13] until the vesting date (e.g. after 10 years of service). The benefit amount increases, because an employee will remain in service until the vesting date to have the benefits vested. When measuring the obligation, the probability that some employees may leave shall be reflected. This probability affects only the measurement of the obligation but does not affect the existence of the obligation (IAS 19, 2011, para. 72).

An employer promising these benefits attributes them to periods in which they will arise. If an employee's benefit will become materially greater, compared to previous years, that benefit must be attributed on a straight-line basis to individual accounting periods (IAS 19, 2011, para. 73). For example, a plan pays a lump sum benefit of CHF 20,000 and the vesting date is 20 years of service. Then a benefit of CHF 1,000 is attributed to each of the first 20 years. The probability that an employee might leave before the vesting date is reflected in the current service cost[6].

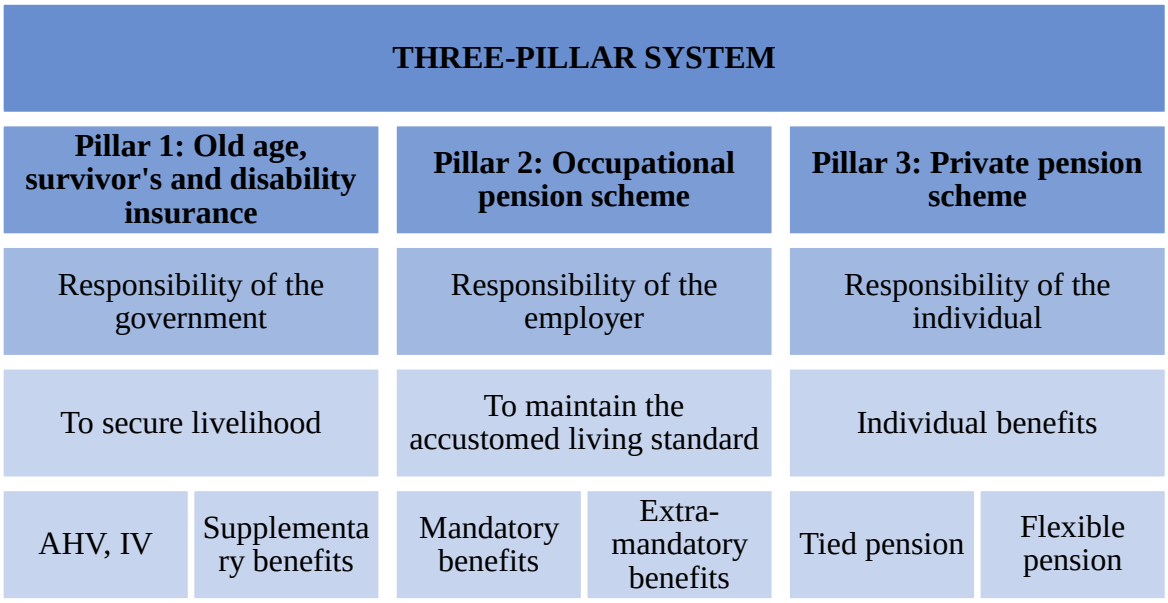
Sometimes the benefit amount is a constant proportion of final salary for each year of service. In that case, a salary increase rate affects the required amount to settle the obligation but does not create an additional obligation. Even though the amount of the benefit depends on final salary, the salary increase rate does not increase the amount of the benefits, since the benefit is attributed on a straight-line basis, as mentioned earlier (IAS 19, 2011, para. 74(a)). The benefit amount is thus a constant proportion of the salary to which the benefit is linked to (IAS 19, 2011, para. 74(b)). For example, if employees are entitled to a benefit of 1% of final salary for each year before the age of 50, then the benefit of 1% of estimated final salary is attributed to each year until the age of 50. At the age of 50, further service does not materially increase the amount of further benefits.

2 THE SWISS RETIREMENT SYSTEM

The Swiss retirement system is provided by public and private institutions and consists of three pillars. The three pillars are summarized in Figure 1.

[13] A constructive obligation arises if past practice creates a valid expectation on the part of a third party (IAS 37, 2011, para. 15).

Figure 1: The Swiss three-pillar pension system



Adapted from AXA Winterthur (2017).

2.1 Old age, survivor's and disability insurance

The first pillar consists of Swiss Federal Old-Age and Survivors' Insurance (ger. *Alters- und Hinterlassenenversicherung*, hereafter: AHV), Swiss Federal Disability Insurance (ger. *Invalidenversicherung*, hereafter: IV), and supplementary benefits. Supplementary benefits are paid by the government and the canton the individual lives in when basic living costs are not covered by the AHV and IV (Federal Constitution of the Swiss Confederation (2018), Art. 112a (1)). The first pillar is compulsory for everyone and should secure a minimal standard of living (Schweizerische Eidgenossenschaft, 2018). It is funded through contributions by insured and employers, where the latter must pay half of the employee's contribution (Federal Constitution of the Swiss Confederation (2018), Art. 112 (3(a))). The contribution to the first pillar starts at the age of 17 and ends when the insured reaches the retirement age (AXA Insurance Ltd., 2019a). Withdrawal 1-2 years in advance is possible as well as an up to 5-year deferral.

The AHV and IV are organized as a pay-as-you-go system, meaning that the working generation is paying for the retired generation. Therefore, it is sensitive to demographic changes (Eling, 2013). The system spends approximately the same amount it receives in each year (Bundesamt für Statistik, 2019). Supplementary benefits are funded by the Federal and cantonal tax (AXA Insurance Ltd., 2019a).

As from 01.01.2019, the minimum monthly old-age pension is CHF 1,185 and the maximum is CHF 2,370. The maximal yearly pension that an individual can get from the first pillar is

called the AHV pension, which is CHF 28,440 (Bundesamt für Sozialversicherungen BSV, 2018).

In 2017, 86% of all new retirees received their old-age pension at the legal retirement age[14] of 65 for men and 64 for women. In 2018 there were 2,363,800 pensioners receiving an old-age pension, 191,100 receiving survivor's pensions, 52,600 receiving the supplementary pensions, and 217,900 receiving disability pensions[15] (Bundesamt für Statistik, 2019).

2.2 Occupational pension scheme

The second pillar consists of an occupational pension scheme, which is compulsory for employed individuals earning at least CHF 21,330 a year (Federal Constitution of the Swiss Confederation (2018), Art. 113 (2(b)), BVG Art. 7). It comprises of employee benefits insurance provided under Swiss Federal Law on Occupational Benefits (ger. *Berufliches Vorsorge Gesetz*, hereafter: BVG) and accident insurance (ger. *Unfallversicherungsgesetz*, hereafter: UVG) provided under Swiss Federal Law on Accident Insurance. The scheme is funded from the contributions of the employees and the employers, where the latter have to pay a minimum of 50% of the employee's contributions (Federal Constitution of the Swiss Confederation (2018), Art. 113 (2(e))).

Mandatory insurance starts when entering a working relationship and ends when the retirement age is reached. The normal retirement age is reached on the first day of the month following the completion of the 65th year of age for men or the 64th year of age for women. The insured person may, with the agreement of the employer, demand early retirement at the earliest on the first day of the month following the completion of the 58th year of age. The accrued savings can be paid out when an employee reaches the age of 58, in the form of either a monthly pension or a lump sum payment (see chapter 3.2.4). It is possible to withdraw the savings before reaching the retirement age, but only to buy or build a home, move permanently abroad or start a business (Schweizerische Bundeskanzlei, n.d.a).

The second pillar is organized as a capital-funded system, meaning that everyone is responsible for their own savings. The contributions made to the second pillar are invested in the capital markets to earn returns and secure the retirement savings in the long term (AXA Insurance Ltd., 2019b). In 2017 there were 1,643 pension funds in Switzerland, with 4,177,769 active members and 773,299 pensioners. The pensioners received an average annual old-age pension of CHF 29,119 or a lump sum of CHF 188,842 (Bundesamt für Statistik, 2019).

[14] In Slovenia the retirement age is set at 64 years for both men and women, with 20 years of insurance, and 65 years with 15 years of insurance, according to Art. 27 of Pension and Disability Insurance Act (2018).
[15] Disability is defined as a "full or partial earning incapacity that is likely to be permanent or persist in the longer-term" (Bundesamt für Statistik, 2019).

Only a part of an employee's annual salary is insured in the occupational pension scheme because a part of the salary is already insured in the first pillar. This insured part is called the coordinated salary and it ranges from CHF 24,885 to CHF 85,320 (BVG, 2019, Art. 8). For the so-called mandatory part, the coordinated salary has to be insured by every employer. If the coordinated salary is less than CHF 3,555[16] in a year, it must be rounded up to this amount. If the coordinated salary exceeds the CHF 85,320, it is allocated to an extra-mandatory portion and the benefits from the pension fund are considered voluntary (AXA Insurance Ltd., 2019b).

2.2.1 Benefits

The following benefits are an example of benefits a pension fund may provide to the policyholders:

- termination benefits,
- retirement benefits (lump sum and pension),
- survivors' benefits, and
- disability benefits.

Termination benefits are the retirement savings accumulated in the pension fund and are paid out if a person has ended the employment relationship and leaves the company's pension fund. These benefits depend the most on the employee turnover rate and the amount of retirement savings (see chapter 3.2.3).

Individuals are entitled to retirement benefits at the time of retirement, but not before the age of 58. In contribution-based pension schemes, the benefit level depends on accrued retirement savings at retirement age and is generally paid as a pension, but may also be drawn as a lump sum (see chapter 3.2.4). The retirement benefit is calculated as an individual's retirement savings multiplied by the so-called conversion rate (described in chapter 3.2.5), which is a minimum percentage of 6.8% at regular retirement age applicable on the mandatory part of the pension accruals (BVG, 2019, Art. 14). A lower conversion rate is used for early retirement and a higher conversion rate for deferred retirement. The retirement savings consist of retirement credits, retirement savings that were transferred from the previous pension scheme, and interest earned on these amounts (BVG, 2019, Art. 15). The minimum interest rate is set by the Federal Council and is adjusted at least every 2 years. In 2019 the minimum rate is equal to 1% (see chapter 3.3.2). Retirement credits are employer and employee contributions that accrue as retirement savings (AXA Insurance Ltd., 2018). The annual retirement credits depend on the age reached and are determined as a percentage of the coordinated salary as follows in Table 3.

[16] The amount CHF 3,555 is the difference between CHF 24,885 and CHF 21,330 (see chapter 2.1).

Table 3: Minimum retirement credits as prescribed by the BVG applicable on the mandatory part of the second pillar pension

Age group (in years)	Retirement credit (in % of the coordinated salary)
25-34	7%
35-44	10%
45-54	15%
55-65 (64 for women)	18%

Source: BVG Art. 16 (2019).

The age is calculated as the difference between the calendar year and the year of birth.

The survivors' benefits are a pay-out to the insured persons' beneficiaries at death. They usually consist of a spousal benefit and an orphan benefit. After the death of an insured person, the spouse can receive 60% of the pension and the orphan 20% from the mandatory part of the pension insurance (BVG, 2019, Art. 21). The right to a spouse pension ceases after they remarry or die. The right to an orphan's pension expires with the death of the orphan or at the age of 18. However, it is valid until the age of 25 for children:

- until the end of their education, or
- until they reach earning capacity, provided that they are at least 70% disabled (BVG, 2019, Art. 22).

Disability benefits are paid out if the insured person becomes disabled before reaching retirement age. The amount of the benefit is calculated based on accrued retirement savings at the start of entitlement to a disability benefit and the sum of future retirement credits up to retirement age (AXA Insurance Ltd., 2018). An insured person can receive a disability benefit if they are at least 40% disabled out of the mandatory part of the pension insurance (BVG, 2019, Art. 23). As per Art. 24 of BVG:

- a person who is at least 70% disabled is entitled to the full disability benefit,
- a person who is at least 60% disabled is entitled to the ¾ of the disability benefit,
- a person who is at least 50% disabled is entitled to the ½ of the disability benefit, and
- a person who is at least 40% disabled is entitled to the ¼ of the disability benefit.

In the Master's thesis, only the second pillar is being considered. We described above the minimum requirements for pension plans. Pension foundations have a large degree of freedom when determining more generous conditions for the benefits (such as the insured salary, contribution levels, and the conversion rate for example). In chapter 4.2 we describe the specifics about the benefit plan that are different or not prescribed by the law.

2.3 Private pension scheme

The third pillar in Switzerland is a voluntary private pension scheme and capital savings instrument which is tax-deductible. It is funded entirely by the insured and consists of two schemes.

The first one, pillar 3a, is called tied pension and is regulated by the government. Employed individuals can pay up to CHF 6,826 per year into the scheme as of 2019, which is the maximal amount that can be deducted from the taxable income (Bundesamt für Statistik, 2019). As the name suggests these retirement savings are tied and can be obtained at the earliest 5 years before reaching the retirement age or in advance under the same conditions as mentioned for pillar 2 (see chapter 2.2) and at the latest 5 years after reaching the retirement age (AXA Insurance Ltd., 2019c).

The second one, pillar 3b, is called flexible pension and is not subject to government regulations. Individuals can pay any amount they want into the pillar and there are no conditions to withdraw retirement savings in advance. Payments made into the scheme are not tax-deductible (AXA Insurance Ltd., 2019c). Any investments meant for the retirement funding are included in this pillar, for example, life insurance policies, savings accounts, and real estate (Schweizerische Bundeskanzlei, n.d.a).

3 ACTUARIAL ASSUMPTIONS

In this chapter, we give more insight into actuarial assumptions. We discuss their importance for pensions and the need for choosing appropriate assumptions. We also examine each assumption thoroughly; from what the accounting regulation says about them to how they should be chosen by companies. For each assumption, we give some Swiss-specific information, such as which values are commonly used in the Swiss pension market.

3.1 The need for actuarial assumptions

European Actuarial Consultative Group (2001) states that the promise to pay a defined retirement benefit commits the entity to pay a certain amount of money, however, the timing and duration are neither fixed nor certain, but depend entirely on when the recipient retires and dies. If the benefit is defined by reference to final salary than the amount of the benefit is also uncertain. When the entity promises to pay a certain amount of benefits, they know that the actual payment of these benefits might be made with a delay, sometime in the future. The need for actuarial involvement, therefore, arises from the requirement to value post-employment benefit obligations. The actuary must make assumptions about future events to approximate future benefits, but also make other decisions because the “cost” of the pension promise is normally recognized gradually over the period during which the employer benefits from the services of the employee. This spreading of cost can be made in several

different ways and thus involves the actuary in choosing the calculation method to be used to cover the cost of benefits.

According to paragraph 59 of IAS 19, the standard encourages but does not require an entity to involve a qualified actuary when measuring benefit obligations. Assumptions can, therefore, be determined at a firm's discretion, even if they have an actuary, and might be subject to exploitations to "improve" the company's earning. Some companies use unusual pension plan assumptions to mislead investors (Mcbride, 2018). Actuaries do not have a completely free choice when it comes to choosing assumptions and calculation methods. Three different regulators may make certain restrictions and the aims may be conflicting when the actuary makes calculations. These bodies are taxation authorities, supervisory authorities, and accountancy bodies (European Actuarial Consultative Group, 2001).

Brown (2004) found in his study of the relation between firm value and financial reports that firstly, the magnitude of pension-related liabilities can be large (the mean pension obligation was 24% of equity value). The effect of changes in estimates compounds over many years, therefore, small changes in the assumptions can add up and generate material disparities in liabilities. For example, an increase or decrease of 1% to the discount rate would change the value of the liability by 15% (Fasshauer & Glaum, 2009). Secondly, actuarial assumptions are long-term assumptions in nature and we cannot measure them precisely. Managers make estimates for them, which could be false, in which case it would be difficult to spot the errors. Thirdly, compared with other aspects of financial reporting that are subject to managerial discretion the technical reporting requirements for pensions are relatively complex. It is thus less likely that market participants could unravel reported pension data and restate them in an alternative form for the purpose of equity valuation. Finally, Brown (2004) concludes that compared to other aspects of financial statements, pension obligations are more likely subject to bias because managers face incentives to report opportunistically even if equity investors and analysts can see through the opportunistic reporting.

Actuarial assumptions are divided into two categories: demographic assumptions and financial assumptions. Willis Towers Watson (2010) summarizes that demographic assumption influence the timing and probability of benefits being paid, while financial assumptions influence the size of the benefits. Remeasuring pension liabilities with updated assumptions leads to actuarial gains or losses; this is called reconciliation. To determine the present value of the liabilities (i.e. the DBO), benefit payment cash flows are projected and then discounted to the present time. This reflects that the amount that is held now to meet future liabilities can be invested and gain additional income before the benefits are paid out (European Actuarial Consultative Group, 2001).

Paragraphs 75 and 76 of IAS 19 state that actuarial assumptions must be unbiased[17] and mutually compatible[18], as they are "an entity's best estimate of the variables that will determine the ultimate cost of providing post-employment benefits".

3.2 Demographic assumptions

Demographic assumptions are used to project the development of the population of the pension fund and hence when the benefits to be provided will be paid, but also how the population will progress (European Actuarial Consultative Group, 2001).

Demographic assumptions include for example:

- mortality rates and mortality improvements,
- disability rates,
- employee turnover rates,
- lump sum payment probabilities, and
- retirement probabilities and conversion rates.

Death, disability, employee turnover, and retirement age determine when the benefits will be paid. Lump sum probability and conversion rate affect the amount of the benefit.

Boulanger, Cossette and Oullet (2007) report that in the decades to come most industrialized countries will experience aging of the population, caused by drop-in birth rates and a rise in life expectancy. Factors that influence population changes are therefore total fertility rate, net migration, and life expectancy. These will have a significant impact on the characteristics of the active population and on the future income and disbursements of the public pension plan.

Chand and Jaeger (1996) characterize an aging society by a growing proportion of the retired to the active working population, so in principle, individuals should be responsible for their own retirement, while in practice they depend on publicly supported schemes. Observed, already in 1996, was that the issue of disbursements of this burden will be a controversial topic as the working population declines and on the other hand the political strength of the elderly increases.

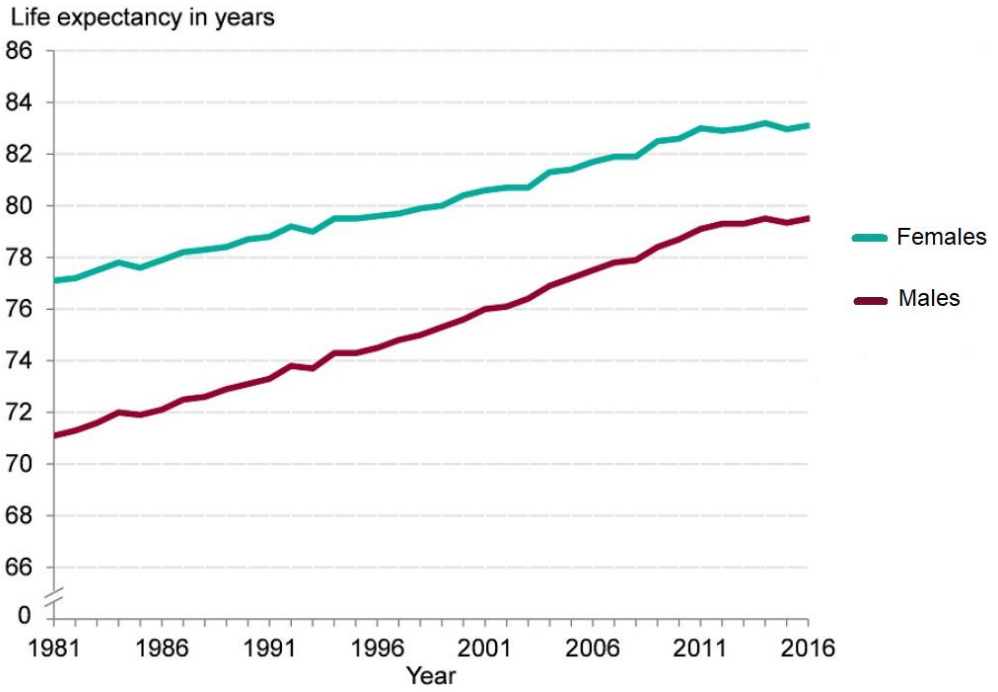
[17] "Actuarial assumptions are unbiased if they are neither imprudent nor excessively conservative" (IAS 19, 2011, para. 77)

[18] "Actuarial assumptions are mutually compatible if they reflect the economic relationships between factors such as inflation, rates of salary increase and discount rates. For example, all assumptions that depend on a particular inflation level (such as assumptions about interest rates and salary and benefit increases) in any given future period assume the same inflation level in that period" (IAS 19, 2011, para. 78).

3.2.1 Mortality rate

When an entity approximates the amount of employee benefits a crucial piece of information is how long the employees receiving the benefits will live. The life expectancy of employees is set with the mortality rate assumption. Figure 2 demonstrates how life expectancy at birth in Great Britain increased from 1986 to 2016. Women's life expectancy at birth is still larger than for men, but the gap is slowly closing.

Figure 2: Life expectancy at birth in Great Britain



Source: UK Government (2017).

Interestingly, Boulanger, Cossette and Ouellet (2007) observed that the life expectancy gap between women and men in Italy and Japan is expected to grow. They also predict that life expectancy (for certain European countries, the United States and Japan) at age 65 for men will increase on average 3.3 years from 2000 to 2030, and 3.1 years for women, but as future changes in life expectancy are subject to several factors, it is difficult to make long-term predictions.

Life expectancy is hence a factor that is changing constantly, that is why longevity risk is a real threat to companies. Longevity risk is the risk that people will live longer than expected. The Economist (2014) reports that longevity is potentially very expensive, as an increase of the average lifespan by 1 year can increase the world's pension bill by 1 trillion dollars. While a longer lifespan is positive for individuals, as they are expected to live longer lives, for companies this means they possibly need additional assets to cover their potentially increasing future liabilities.

Mortality assumption affects the value of the DBO thus realistic assumption are necessary. Companies should actively evaluate the most recent mortality experience, have updated assumptions, and recognize the risks to which they are exposed (OECD, 2014). Mortality assumptions must be determined as best estimate of the mortality of plan members (IAS 19, 2011, para. 81). Expected changes in mortality need to be taken into consideration, when estimating the DBO, for example, by additionally considering mortality improvements (IAS 19, 2011, para. 82).

3.2.1.1 Mortality tables

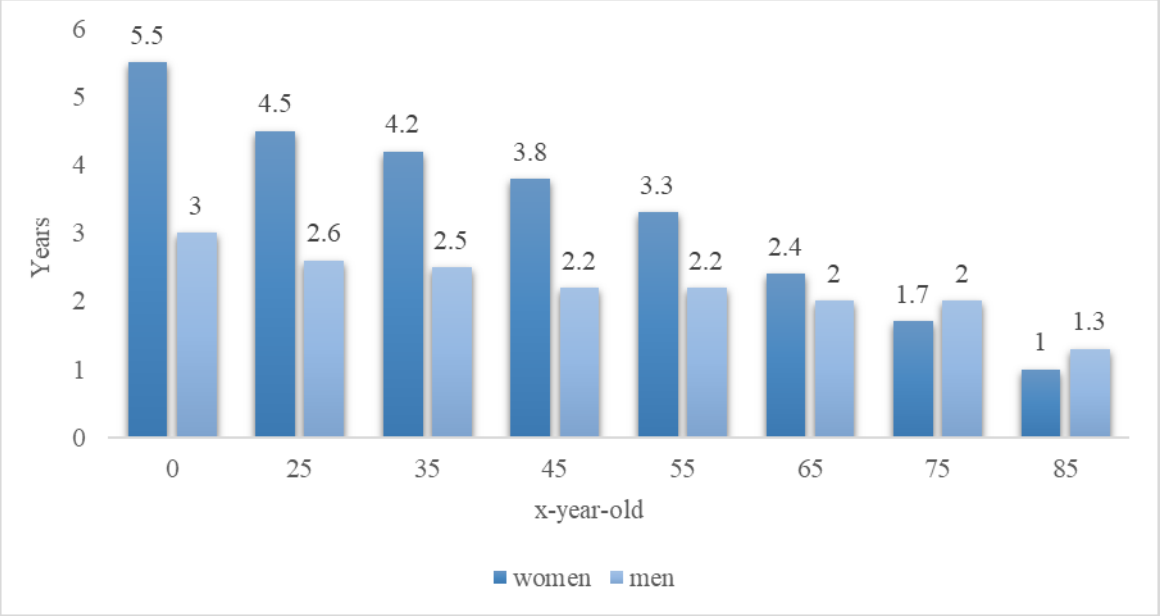
Mortality rate assumptions are commonly presented in so-called mortality tables with mortality probability q_x, which is the probability that an individual aged x dies within the next year (q_y is usually used for women). It is usual to have two mortality tables, one for women and one for men, but OECD (2014) reports that unisex mortality tables are also being used. Mortality tables can be static (also called one-dimensional) and generational (also called two-dimensional). Static tables only have one mortality probability per age, on the other hand, generational tables consider that life expectancy changes over time, so mortality probability should change as well.

To understand the difference between the two tables let us consider the following example of a 70-year-old individual with a mortality probability of dying before the age of 71, q_{70}, being 2%. If we have a static table, this probability will not change over time: a person who will be 70 years old in 1 years' time and a person who will be 70 years old in 40 years' time will have the same mortality probability of 2% based on a static table. Meanwhile, in a generational table, an individual who will be 70 years old in the next year will already have a different mortality probability, for example, 1.96% assuming that mortality is decreasing. Compared to static tables, generational tables are harder to evolve as the following two components must be approximated: the current rate of mortality and mortality improvements[19]. OECD (2014) observed that several companies opted to use a static table multiplied with some kind of improvement factor that accounts for future mortality changes.

AON Hewitt (2014) reported that in the past, mortality rate assumptions did not include how the population was developing and in some countries, assumptions have not been changed in over 10 years. For example, in the USA mortality tables were changed to new tables after 14 years (from mortality table RP-2000 to RP-2014). Figure 3 shows the difference in life expectancy when the new RP-2014 tables were introduced.

[19] The name mortality improvement suggests, that mortality will decrease in the future and hence life expectancy will increase. Mortality improvement therefore measures the reduction in mortality rates from one year to the next (Continuous Mortality Investigation Limited, 2018).

Figure 3: Life expectancy increase according to RP-2014 from RP-2000



Adapted from AON Hewitt, Retirement and Investment (2014).

The use of certain mortality tables can be enforced by the regulatory framework, as these tables include minimal mortality assumptions and may include future mortality improvements (OECD, 2014). Mortality table regulation can differ between different countries, but also between companies within the same country. OECD (2014) observed the following differences between countries. In the USA the commonly used mortality tables are static tables multiplied with an improvement factor, and in countries such as Canada, France, Germany, Switzerland, and the United Kingdom generational tables are predominantly used.

In Switzerland, the mortality tables are based on a base mortality table (e.g. BVG 2015[20]) and future mortality improvements (e.g. Menthonnex or CMI 2016 (KPMG, 2018)). Swiss BVG tables are supposed to change every 5 years, with the next publication release of BVG 2020 tables scheduled in December 2020 (Libera AG, Aon Schweiz AG, 2015). For the sensitivity analyses, we used the BVG 2015 tables.

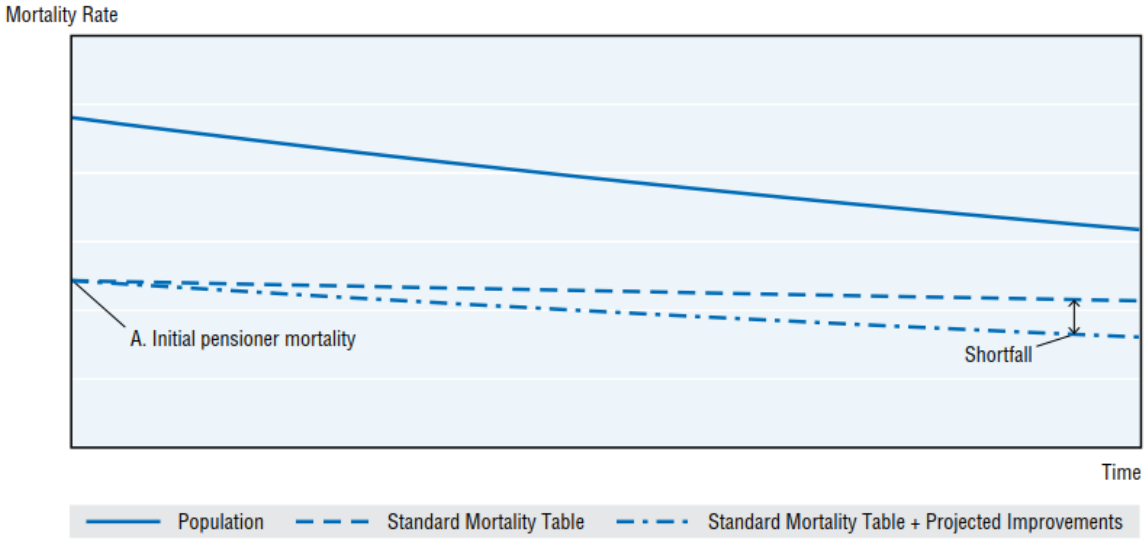
In Slovenia, companies tend to use different mortality tables. For example in 2018 some of the mortality tables used were the Slovenian mortality table 2000-2002 (UniCredit Banka Slovenija, 2019), the Slovenian 2007 mortality table (Zavarovalnica Sava, 2019; Adriatic Slovenica, 2019), and crude mortality tables for the population of Slovenia from 2017 (Zavarovalnica Triglav, 2019). Slovenia's biggest insurer, Zavarovalnica Triglav (2019), also reported that they use a 20% lower mortality than the one in the mortality tables.

[20] BVG 2015 is based on the observation of 15 large pension schemes between 2010 and 2014 (Libera AG, Aon Schweiz AG, 2015).

3.2.1.2 Mortality improvements

OECD (2014) observed that if a company uses mortality assumptions that do not really reflect current mortality rates and future improvements when valuing their obligations, they are exposing themselves to longevity risk and can have understated provisions. Figure 4 presents how an individual's mortality is affected over time by applying projected mortality improvements on a standard mortality table.

Figure 4: Effect of including projected mortality improvements on mortality tables



Source: OECD (2014).

The shortfall seen in Figure 4 is the consequence of not using mortality improvements for determining the mortality rate. Companies that do not use mortality improvements have a higher mortality rate assumption, which could affect the company's pension liabilities. OECD's analysis showed that not using projected mortality improvements can lead companies to have up to 10% undervalued provisions for future obligations.

In Switzerland, two mortality improvements models have been developed, according to OECD (2014): the Nolfi model and the Menthonnex model.

The Nolfi model uses a constant improvement factor by age over time. It is described by equation (2), which implies that mortality decreases exponentially over time (Nolfi, 1959).

$$q_{x,t} = q_{x,t_0} \cdot e^{-\lambda_x (t - t_0)}, \text{ where } \lambda_x = -\frac{\log(0.5)}{\max(40,x)} > 0 \qquad (2)$$

With:

t_0:	initial year ($t_0 < t$)
x:	age

$q_{x,t}$: probability of dying before reaching age $x+t$ at the age of x
$q_{x,t0}$: probability of dying before reaching age $x+t_0$ at the age of x
λ_x: mortality improvement factor (age-specific)

The denominator in λ_x is the period of time after which the mortality rate of a person of age x will be halved. The bigger the λ_x, the more the expected mortality decreases over time.

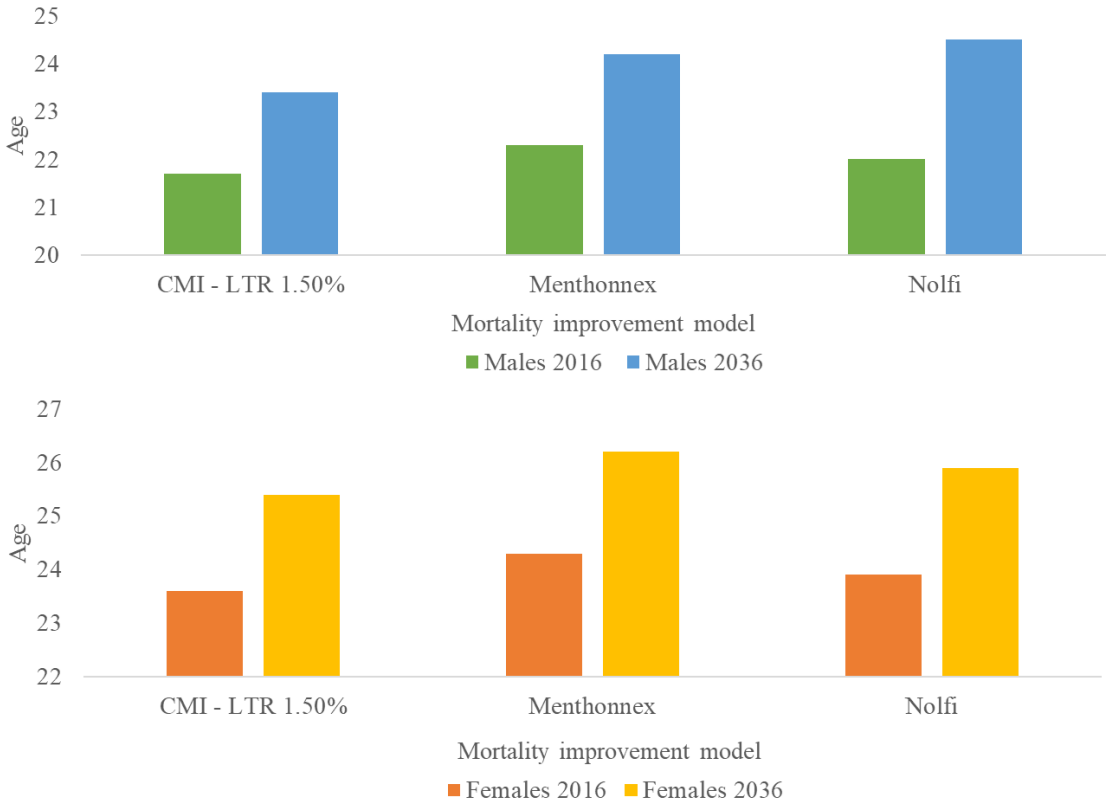
The Menthonnex model is made so that it eventually converges toward a lower long-term improvement rate. This improvement is already included in the BVG 2015 mortality tables which are described in chapter 4.4.

In the United Kingdom, the Continuous Mortality Investigation (hereafter: CMI) model for mortality improvement is used, developed by the Institute and Faculty of Actuaries. To project mortality improvements CMI has developed a model where users specify a long-term (future) rate (hereafter: LTR) of improvement, which is usually set between 1.00% and 2.00% per year (Aon Switzerland Ltd., Retirement, 2017). The CMI publishes a mortality projections model that is updated annually to reflect new population data. Although the CMI publishes a version of its model calibrated to UK data, the model itself can be calibrated to data from any country (Continuous Mortality Investigation Limited, 2018). The CMI model is, according to KMPG (2018), seen as being more sophisticated than the Menthonnex model by some actuaries due to its increased number of parameters and better ability to project the continuation of the so-called cohort effect whereby individuals born in certain time periods experience different levels of mortality improvements to others. CMI (2018) reports that mortality improvements since 2011 have been much lower than earlier in the 21st century and that they peaked in 2003 for males and 2005 for females. The average mortality improvements since 2011 have been 0.5% per year for males and 0.1% for females. In Figure 5 we can see how cohort[21] life expectancies at age 65 (based on mortality table BVG 2015) change if the companies use different mortality projections.

The mortality projections used in Figure 5 are CMI – LTR 1.50% per year, Menthonnex method, and Nolfi method. Menthonnex method results in the highest cohort life expectancy, while CMI in the lowest. None of the mortality improvements are necessarily better than the others, therefore companies should choose the one which is best suited for them.

[21] In this context cohort stands for a group of individuals born around the same time.

Figure 5: Cohort life expectancies at age 65 according to different mortality improvement models



Adapted from Aon Switzerland Ltd. (2017).

For sensitivity analyses, Menthonnex mortality improvement was considered. The Nolfi method is not as commonly used in the Swiss market and the CMI mortality improvements are too complex to implement within the limitations of the Master's thesis.

3.2.2 Disability rate

The disability rate is the probability that an active employee becomes disabled in the current annual reporting year. Disability rates are used when the plan contains provisions for special benefits upon disability, but if this is not the case, they are generally incorporated in the turnover assumption (Oliver, 2009). The valuation of disability benefits is typically binary, either the individual is disabled or not, but, an individual may become partially disabled and therefore only receive part of the disability benefit from their pension fund.

KPMG (2018) reports that in Switzerland the BVG 2015 standard disability rates include all cases in which individuals have a high enough degree of disability to receive a disability benefit, which is commonly 40% and up. Therefore, companies sometimes adjust their disability rates downwards by applying a loading factor, because some individuals will only receive part of the disability benefit. Many pension schemes are not large enough to derive

and/or justify using experience adjusted probabilities and should therefore not use scaling factors, but a standard disability table (Plamondon, et al., 2002).

As disability benefits are costlier to a plan than the benefits an individual would receive if they were not disabled, reducing the assumed disability rate by applying a loading factor generally reduces the calculated liability. For example, applying a loading factor of 80% is commonly denoted as 80% BVG 2015, meaning the disability rate from table BVG 2015 is multiplied by 80%.

3.2.3 Employee turnover rate

Frees (2003) defines employee turnover as a type of employee exit from an employment arrangement and therefore a pension plan, other than death, disablement, and retirement. This is of interest to employers, because of the costs associated with screening, hiring, and training new employees. Employee termination affects the finances of employee benefit plans and is as thus a concern to actuaries. Increasing (decreasing) employee turnover generally reduces (increases) pension liabilities. As an employee leaves, in Switzerland, their accumulated account balance transfers to another arrangement and the requirement to provide interest credits and conversion to pension is removed. Where termination rates are based on existing tables, a loading factor may be added to reflect the group's experience to the extent it is considered credible (Oliver, 2009). Loading factor on the turnover rate is commonly denoted, for example, as 125% BVG 2015.

KPMG (2018) noted that in Switzerland 66% of companies use the standard BVG 2015 employee turnover scale and most of the remaining companies apply a loading factor to increase or decrease the rate in standard tables.

In Slovenia, companies seem to also use either data in mortality tables or derive a fixed percentage from their own experience. The average turnover rate used seems to be around 2.9% (Zavarovalnica Triglav, 2019; Zavarovalnica Sava, 2019; Gorenje, 2019), but some rates could go as high as 18% (Adriatic Slovenica, 2019).

3.2.4 Lump sum payment or capital option

The lump sum probability showcases the expected portion of retiring employee's benefit to be taken out as a lump sum rather than a pension. Lump sum payments are also known as capital options. UBS (2019) gives individuals the following factors to consider when taking out a lump sum payment rather than a pension:

- single status,
- plans to make a significant investment,
- unused retirement savings can be inherited,

– short life expectancy due to health problems,
– flexible accessibility of savings, and
– intention to work past the retirement age.

Companies must assess what percentage of their employees will take a capital option at retirement. A high percentage is considered as optimistic (although unrealistic) because people usually decide for a pension as the current annuity conversion rate pattern in most Swiss pension plans is considered more favourable than the expected investment returns on the corresponding lump sum. The companies benefit if more employees choose the capital option than expected because they can avoid longevity risk and their liabilities get reduced as the present value of the annuity is in most cases higher than the present value of the available assets including expected investment returns available to cover the annuity. In Switzerland, a median percentage of employees deciding for the capital option in 2017 was 25%, but some companies used an assumption as high as 60% (KPMG, 2018).

3.2.5 Conversion rate

The Swiss government sets the conversion rate at which the accumulated retirement assets are converted into a pension. The rate goes together hand in hand with retirement ages because it is a function of the retirement age, so reducing conversion rates can be avoided by increasing the retirement age (Eling, 2013).

The amount of the retirement pension depends on the conversion rate because the existing pension is multiplied with it. The minimum conversion rate prescribed by the BVG in Switzerland for the so-called compulsory part of pension savings (or mandatory-part) is 6.8% for 65-year-old men and 64-year-old women, which is above the actuarially fair rate. For accumulated pension savings of CHF 100,000 this conversion rate results in a pension of CHF 6,800 per year. This means that Switzerland's second pillar, which is a capital-funded system, is also affected by demographic changes (Eling, 2013).

Vermögens Zentrum[22] observes that for the determination of the level of the conversion rate two things are pivotal. Firstly, the life expectancy of the individual at retirement, because at that time the existing retirement capital must be sufficient. Secondly, the expected return on retirement capital, since the pension fund pays out the money gradually (like monthly) and keeps the rest for as long as possible.

When the BVG was introduced in 1985, the legal conversion rate for men and women was 7.2%. Since then life expectancy has increased significantly for both men and women and the interest rates have declined. Although the legal conversion rate was lowered gradually to 6.8%, with the current life expectancy, however, the pension funds would have to generate

[22] Vermögens Zentrum is an independent investment adviser and asset manager. It was founded in 1993 in an effort to bring transparancy to the Swiss insurance and banking industries.

on average a return higher than 4.5% per annum to secure the pension funding long term (Vermögens Zentrum).

A significant reduction in the legal conversion rate seems inevitable. In 2017 however, the Swiss voters rejected the reform project "Altersvorsorge 2020" at the polls, which would have lowered the minimum conversion rate to 6%. The next reform proposal is scheduled in 5 years' time and would again include a reduction in the conversion rate. Because the conversion rates are above their actuarially fair value, they have already significantly reduced most pension funds in recent years. Those that have not adjusted their conversion rates for a while to increasing life expectancy and low interest rates will urgently need to significantly lower the conversion rate.

How a decrease in conversion rates affects the pension of future retirees is shown in the following example. In 10 years an individual is supposed to have accumulated CHF 650,000 in his pension fund. If this amount were converted into a pension at the conversion rate of 6.4%, he would receive CHF 3,467 per month. But the pension fund must gradually lower its conversion rate to 5.2% so the pension shrinks to CHF 2,817 per month, which is a loss of CHF 650 per month or CHF 7,800 per year.

If the conversion rate is set too high the retirement savings of a retiree are insufficient to pay for all his pensions. For some years now, this has led to an undesirable redistribution of the assets of employed persons to pensioners in Switzerland and as well to a redistribution from extra-mandatory to mandatory retirement savings. Affected are above all well-earning employees, whose extra-mandatory retirement savings generally exceed the obligatory amount (Vermögens Zentrum).

3.3 Financial assumptions

To project the amount of benefits that will be payable, financial assumptions are required (European Actuarial Consultative Group, 2001).

Financial assumptions can include the following parameters:

- discount rate,
- interest credit rate,
- inflation,
- salary increase rate,
- social security increase, and
- pension increase.

The financial assumptions must be determined in nominal terms unless real terms (i.e. inflation-adjusted) are more reliable, which is the case in a hyperinflationary economy (IAS 19, 2011, para. 79). Moreover, they must be based on the end of the reporting period market

expectations “for the period over which the obligations are to be settled” (IAS 19, 2011, para. 80).

Financial assumptions are correlated to each other, therefore assuming independence is not realistic. For example, inflation influences other financial assumption, such as the discount rate, and the salary increase rate (Willis Towers Watson, 2018).

3.3.1 Discount rate

The discount rate helps determine the present value of pension liabilities. Paragraphs 84 and 85 of IAS 19 state that the discount rate:

- reflects the time value of money,
- reflects the currency and the estimated timing of benefit payments,
- does not reflect the actuarial or investment risk,
- does not reflect the entity-specific credit risk, and
- does not reflect the risk that future experience may differ from actuarial assumptions.

“In practice, an entity often achieves this by applying a single weighted average (duration) discount rate that reflects the estimated timing and amount of benefit payments and the currency in which the benefits are to be paid” (IAS 19, 2011, para. 85). As the discount rate reflects the time value of money, a higher discount rate reduces the DBO, while a lower discount rate increases it.

In an explanation of the discount rate requirements accompanying IAS 19, according to the IFRS, Staff paper (2016), is noted that the International Accounting Standards Board[23] decided that the discount rate should reflect the time value of money, but should not attempt to capture the risks associated with a DBO. The discount rate must not reflect the entity’s credit rating, because an entity with a higher credit rating would recognize a bigger liability and an entity with a lower rating a smaller liability. The rate that best achieves these objectives is the yield on high-quality corporate bonds (hereafter: HQCB) (Gomes, Heeralall, Poli & Sommer, 2017). Paragraph 83 of IAS 19, therefore, states that the discount rate “should be determined by reference to market yields at the end of the reporting period on HQCB”. This is how the discount rate is determined in Switzerland (IFRS Staff paper, 2016). In countries where there is no deep market in such bonds, paragraph 83 says that the market yields on government bonds shall be used.

However, in IAS 19 it is not specified which corporate bonds qualify as HQCB. The commonly used practice, to determine which bonds are high quality, is to look at the ratings given by a recognized rating agency (e.g. “AAA” and “AA”) (IFRS Staff paper, 2016).

[23] The International Accounting Standards Board is an independent, private-sector body that develops and approves International Financial Reporting Standards (IFRSs). It operates under the oversight of the IFRS Foundation.

Corporate bonds rated higher than AA are considered as HQCB but because of the financial crisis many highly-rated bonds' ratings have fallen (i.e. the volume of bonds rated AA or higher decreased). The answer to this from the IFRS Interpretations Committee was that the concept of high quality should not change over time, so a reduction in the number of HQCB should not result in a change to the concept of high quality.

Kasaoka (2015) stated that in Europe the following five methods were adopted by firms to set their discount rates:

- Yield curve direct approach: several discount rates are used, which are calculated based on spot rates with different estimated payment periods according to employees' retirement dates.
- Yield curve equivalence approach: a single weighted average discount rate is used, which leads to the same amount of DBOs calculated under the yield curve direct approach.
- Yield duration approach: a single weighted average discount rate is used, which is a spot rate with a time-period equivalent to the duration of DBOs.
- Index approach: the discount rate is set based on average trading values on HQCB or yield value on bond indexes with consideration of the average estimated period of benefit payments on defined benefit plans. It does not use the yield curve.
- Sample cash-flow approach: the discount rate is set based on sample cash flows with different features, including durations under many defined benefit plans.

Discount rates in Switzerland, for example, tend to differ according to KPMG (2018) because of:

- the HQCB selection criteria,
- which yield curve construction model was used, and
- how to allow for a limited number of long-duration bonds.

Bui and Randazzo (2015) analysed some discount rate myths, among others, one is that the discount rate should match the expected rate of return. The reasoning behind it is that if a plan is expected to earn a certain rate on its investments it is consistent to assume the liabilities should be discounted using the same rate. However, they argue that this is false because the value of an asset and the liability cannot be considered together, but separate. The next myth is that long-term investment strategies justify high discount rates, argued because of time diversification. While the average rates of return do become less volatile in the long run, the cumulative returns do not and they lead to significant differences over time. Cumulative investment risk therefore actually increases over time due to the compounding effect of returns, so even if managers could reduce asset risk this would not justify a high discount rate on liabilities as stated before that asset risk should be considered separately from liability risk.

Following paragraph 83 of IAS 19, the discount rate is reviewed annually. The change in the rate is reflected in the amount of the DBO and recognized as actuarial gains and losses in other comprehensive income immediately, and are not recycled to profit or loss (IAS 19, 2011, para. 122).

Fried, Davis-Friday and Davis (2010) argue in their study that firms use higher discount rates to minimize their DBO which is reflected in the statement of financial position, but the statement of profit and loss is affected through service costs and net interest (see chapter 1.3.1). The discount rate is used to calculate both service and interest cost under IAS 19, so they are both sensitive to fluctuations in the discount rate. An increase in the discount rate lowers service costs, but it can decrease or increase interest costs. They also note that managements prefer higher discount rates because they lower DBO, service costs, and interest costs, however, these results depend also on duration. Duration is the weighted average time until payments are made. Plans with young workers have a long duration because a lot of time will have to pass before any payment is made. For short-duration plans, interest costs are high relative to service costs, so higher discount rates increase interest costs and therefore have less of a significant effect on liabilities and service costs. In conclusion, managements prefer a high discount rate for plans with long durations and low discount rates for plans with short duration, since they lower net pension expenses while only slightly increasing the liabilities (Fried, Davis-Friday & Davis, 2014).

Regulators therefore often prescribe discount rates. The Swiss Chamber of pension actuaries publishes average discount rates for the valuation of pension liabilities for Swiss companies under international accounting standards. The range for valuations with a liability duration of 10 years as of March 31, 2019 ranges from 0.26% to 0.36%, 0.45% to 0.55% for a duration of 15 years, and 0.53% to 0.65% for a duration of 20 years (Schweizerische Kammer der Pensionskassen-Experten, 2019).

In Slovenia some reported discount rates as at December 31, 2019 for a duration of 10 years were 1.04% (Zavarovalnica Triglav, 2019), 0.776% (Zavarovalnica Sava, 2019), and 1.9% (UniCredit Banka Slovenija, 2019).

3.3.2 Interest credit rate

The level of future benefits depends on the interest credit rate that is credited to savings accounts. To project the interest paid on pension savings accounts of the employees, interest credit rate assumptions are determined. They depend primarily on the capacity of the pension scheme to distribute asset returns which in principle can be used to either grant interest on the pension accounts of working employees, to pay pensions in payment or can be used to increase provisions for pensions in payment and for future pensions. As far as the Swiss market is considered the minimum interest credit rate cannot be negative (Kuhn, 2019).

If interest credit rates are low for a prolonged period, they could have an impact on the statement of financial position and statement of profit and loss of the entity. In such economic environment pension liabilities would increase, because future investment returns would be reduced. Pension funds promising certain liabilities with a high guaranteed return may have a hard time fulfilling their promises, even more so if the duration of the liabilities is longer (Antolin, Schich & Yermo, 2011).

For sensitivity analyses, we considered the minimum interest credit of 1%. In Slovenia, Adriatic Slovenica (2019) reported in their 2018 annual report to use an interest credit rate between 1.5%−4%.

3.3.3 Inflation

Inflation is an important financial assumption to project the evolution of pensions to reflect price increases in the economy. Past data on inflation are generally available from national statistical offices or the data may also be available on short and even long-term forecasts by these institutions or by other government agencies (Plamondon, et al., 2002).

All the financial assumptions should include the same assumption regarding inflation, such as the discount rate or the salary increase rate (Ruppel, 2017). When setting best estimate assumptions during periods when current rates of inflation are believed to differ from those anticipated over the long term, Oliver (2009) suggests that the inflation rate assumption should consider expected long-term inflation rates and not be based solely on the current inflation rate. When the inflation rate decreases, we have deflation. When there is a period of deflation, entities promising post-employment benefits might have increased liabilities (Punter Southall Briefing Note, 2010). Deflation affects the growth of salaries, which impacts the DBO, see chapter 3.3.4.

For Swiss pension liabilities, the inflation assumption is not generally significant, however, it is often used as a reference for setting the salary increase rate assumption (KPMG, 2018). The inflation assumption in Switzerland is set as best estimate, for example from the Swiss National Bank's (2019) inflation forecast, which as of March 2019, predicts inflation rates between 0.3% and 1.2% for the years 2019-2021. In Slovenia Sava (2019) reported a 1.5% inflation rate for the annual reporting year 2018. In sensitivity analyses, inflation of 1.0% was presumed, since this is a long-term assumption, which has little year-to-year movement (Willis Towers Watson, 2018).

3.3.4 Salary increase rate

The projected salary increase rate assumption is the assumption made by the actuary with respect to future increases in the individual salaries of active plan members. Paragraph 90 of IAS 19 says that "estimates of future salary increase rate take account of inflation, seniority,

promotion, and other relevant factors, such as supply and demand in the employment market". The salary increase rate must be mutually compatible with the inflation rate to ensure at least a real salary growth. For example, with an inflation rate of 1%, to achieve a real growth of 0.5%, the salary increase rate should be set at 1.5%. In Switzerland, salary increase rates between 0% and 2% are common in connection with the historically very low inflation expectations of the last few years (Kuhn, 2019). In Slovenia, the salary increase rate can range from 0.776% to 2.2% as at December 31, 2018 (Zavarovalnica Triglav, 2019; Zavarovalnica Sava, 2019; UniCredit Banka Slovenija, 2019).

In other words, this assumption recognizes that a current employee who will retire in twenty years will likely be earning a higher salary at the time of retirement and this has an impact on the amount of pension benefits that will be paid to the employee since some of these benefits have already been earned (Ruppel, 2017).

In a slow economic environment, characterized by low salary growth, low inflation, and low interest credit rate (see chapter 3.3.2) future pension benefits could also become lower. Low interest credit rate and low inflation reduce the salary increase rate, since they are dependent, so future benefits are also reduced. In theory (i.e. in a perfect equilibrium) the impact of low interest credit rate would be offset by the low inflation and low salary increase rate, so there would be no change in future pension benefits (Antolin, Schich & Yermo, 2011).

3.3.5 Social security increase and pension increase

Social security increase measures the annual expected increase of the first pillar or AHV. EY regards it is a reasonable assumption to set the social security increase slightly above the inflation rate which is aligned to historical behaviour of the Swiss federal government when adjusting first pillar pensions.

Pension increases in Switzerland are not mandatory and are provided at the discretion of the plan. It is not uncommon for pension increase assumptions to be at or just above zero (over 70% of companies had set the assumption to 0%), as reported by KPMG (2013) since in the current economic environment the inflation is low.

These two assumptions rarely change therefore, we did not actively consider them in sensitivity analyses. Social security rate was presumed to be 1.0% and the pension increase rate 0.0%, aligned with the Swiss market (Kuhn, 2019).

4 SENSITIVITY ANALYSIS

This chapter gives details about four important points of a sensitivity analysis, which are: which actuarial assumptions and which parameters were selected, which benefit plan was used, how a test sample from a real pension fund was selected, and a description of the benefit valuation tool with which the DBO was calculated.

For a sensitivity analysis, the Master's thesis does not consider all actuarial assumptions that were described in chapter 3. The reasons behind this are that some of them rarely change (e.g. pension increase) or they are too complex to implement within the limitations of the Master's thesis (e.g. CMI mortality improvement). This does not, however, mean that the assumptions not considered in chapter 4.1 could not have a significant effect on the amount of the DBO.

4.1 Selected assumptions

The following parameters are being considered.

- Demographic assumptions:
  - conversion rate,
  - capital option,
  - loading factor on disability rate, and
  - loading factor on the turnover rate.
- Financial assumptions:
  - discount rate,
  - interest credit rate. and
  - salary increase rate.

Since we want to see how these assumptions change the value of the DBO, we need a DBO starting value, i.e. a baseline value. To calculate the baseline value, we need to select a "baseline parameter value" for each assumption, which in this case means the parameter values that are most commonly used in the Swiss market (see chapters 3.2 and 3.3). These are seen in Table 4. The DBO baseline value (hereafter: baseline DBO) calculated using the baseline parameter values from Table 4 is kCHF 58,370.

Table 5, shows which parameters values (or parameter value changes) are studied for each of the selected assumptions. A decision about how likely it is that parameters might take values within the threshold ranges is also helpful. All the parameter values in Table 5 have a positive probability of occurrence. Based on historical data and EY's internal data it is estimated in Table 5 which parameter values have a higher incident rate (between 50%-80%, denoted by "H") and which a lower probability (less than 50%, denoted by "L"). The baseline parameter values have a very high probability of occurrence (more than 80%, denoted by "VH"). Entities might still use other parameter values, but they need to explain their decisions (Kuhn, 2019).

Table 4: Most common parameter values of actuarial assumptions in the Swiss market

	Baseline parameter values
Demographic assumptions	
Mortality rate	BVG 2015 Menthonnex
Loading factor and disability rate	100% BVG 2015
Loading factor and turnover rate	100% BVG 2015
Retirement age	65 for men, 64 for women
Capital option	25%
Conversion rate	5.5%
Financial assumptions	
Discount rate 31.3.2019 (for a duration of 17.5 years)	0.52%
Interest credit rate	1.0%
Inflation	1.0%
Salary increase rate	1.0%
Social security increase	1.0%
Pension increase	0.0%

Source: Own work based on Kuhn (2019).

For the discount rate, we consider fixed parameter value changes because the values solely depend on financial market developments. As future market movements cannot be predicted it is also not possible to use sensitivities which are better aligned to the expected behaviour of the companies selecting them than others. On account of that, we cannot estimate which parameter values are more or less likely to occur.

Table 5: Parameter values for each selected assumption that are going to be analysed

	Parameter values and probabilities of occurrence				
Demographic assumptions					
Conversion rate	5.0% (H)	5.5% (VH)	6.0% (H)	6.5% (L)	6.8% (L)
Capital option	0% (L)	10% (H)	25% (VH)	50% (L)	100% (L)
Loading factor on turnover rate	50% (L)	75% (H)	100% (VH)	150% (L)	200% (L)
Loading factor on disability rate	80% (L)	85% (L)	90% (H)	100% (H)	125% (L)
Financial assumptions					
Discount rate	0.52%	+/- 0.10%	+/- 0.25%	+/- 0.50%	+/- 1.00%
Interest credit rate	0.5% (L)	1.0% (VH)	1.5% (H)	2.0% (L)	2.5% (L)
Salary increase rate	0.0% (L)	0.5% (H)	1.0% (VH)	2.0% (L)	3.0% (L)

Adapted from Kuhn (2019), Swiss National Bank (2019), Schweizerische Kammer der Pensionskassen-Experten (2019), Swissstaffing (2019).

4.2 Description of the benefit plan used in the valuation

This part of the Master's thesis provides the specifics of a real pension plan organized by an employer for its employees in a pension foundation as described in chapter 2.2. This benefit plan is a typical pension plan in Switzerland (Kuhn, 2019).

The reported salary is the presumed AHV salary (annual gross salary). This salary is the last known AHV salary at the end of the financial year. In doing so, the changes that have occurred or have been agreed for the current year must be considered. If an employee is not employed for a whole year, the definitive salary will be the one he would earn on full-time employment. The income that an employee earns from another employer or from self-employment is not part of the AHV salary referred to in the plan.

The insured annual salary i.e. the coordinated salary (see chapter 2.2) is equal to the AHV salary up to a maximum of CHF 400,000 less a coordination deduction. The coordination deduction corresponds to 7/8 of the maximum AHV pension (see chapter 2.1). This amount will be adjusted according to the level of employment. For example, if a person is employed only 50%, the coordination deduction is also halved.

Pensioners' children's pension is equal to 20% of the pension for each child who could claim an orphan's pension in the event of death.

Survivors' benefits are divided if the insured dies before or after the retirement age. Survivors' benefits at the death of the insured after the retirement age are:

- a spouse's or partner's pension equal to 60% of the pension, and
- an orphan's pension equal to 20% of the pension.

Survivors' benefits at the death of the insured before the retirement age are:

- a spouse's or partner's pension equal to 24% of the insured salary,
- orphan's pension equal to 8% of the insured salary,
- a lump sum death capital maximally equal to the retirement savings available at the time of death, less the sum of the present value of the spouse's pension, annuities for the divorced spouses, and severance payments, and
- an additional lump sum death capital equal to 100% of the coordinated salary.

A disability pension is equal to 40% of the coordinated salary and up to three times the maximum AHV pension and a disability pension is equal to 80% of the coordinated salary between a maximum of three times the maximum AHV pension and a maximum of CHF 400,000.

Disability children's pensions are equal to 8% of the coordinated salary for each child who could claim an orphan's pension in the event of death.

The waiting period for disability pensions is 24 months. After the insured becomes disabled they have to apply for an exemption from contribution payments. The waiting period for such an exemption is 3 months. As a consequence of the granted exemption retirement savings are further increased and bear interest without the disabled employee having to make contributions.

In the case of extra-mandatory savings, a distributed surplus is credited to the individual's surplus account. In cases of retirement and death before the retirement age, the savings balance on the surplus account is paid as a one-off payment in addition to the other regulatory benefits.

4.3 Data and sample selection

For the Master's thesis, EY provided an existing pension plan's dataset with a population of 670 anonymous policies to use for the analysis. The policies come with the following information:

- birth date,
- sex,
- total retirement savings,
- obligatory retirement savings,
- yearly salary, and
- occupational rate[24].

The sample is selected in such a way to represent the Swiss working population by gender and the Swiss population by age. This type of approach is also called stratified sampling[25] and it ensures that every category of the population is represented in the sample and in the right proportions.

From Switzerland's statistical data available from the Federal Statistical Office (2018a) the proportion of employed men is 54.6% and of employed women 45.4%. The proportion of four age groups for each gender in the population is seen in Table 6 as reported by the Federal Statistical Office (2018b).

The dataset EY provided has the proportion between men and women as seen in Table 7 and the proportion between age groups as seen in Table 8.

[24] Occupational rate refers to the percentage of standard working hours an individual is employed for. For example, if the standard working hours are 40 hours per week, a person employed with an occupational rate of 80% is going to work 32 hours per week.

[25] Stratified random sampling is a method of sampling that involves the division of a population into smaller sub-groups known as strata. In stratified random sampling or stratification, the strata are formed based on members' shared attributes or characteristics such as income or educational attainment (Hayes, 2019).

Table 6: Proportions by age group for each gender

Age group	Men	Women
0-19	20.8%	19.3%
20-39	27.3%	26.0%
40-64	35.5%	34.5%
65+	16.4%	20.2%

Source: Adapted from Federal Statistical Office (2018a).

Table 7: Number of policies and proportion by gender in the dataset

	Number of policies	In %
Men	427	63.7%
Women	243	36.3%
Total	***670***	***100.0%***

Source: Own work based on EY's dataset (2019).

Table 8: Number of policies and proportion by age group for each gender in the dataset

	Men		*Women*	
Age group	**Number of policies**	**In %**	**Number of policies**	**In %**
0-19	0	0.0%	1	0.4%
20-39	235	55.0%	146	60.1%
40-64	191	44.7%	96	39.5%
65+	1	0.2%	0	0.0%
Total	***427***	***100.0%***	***243***	***100.0%***

Source: Own work based on EY's dataset (2019).

The proportions in EY's dataset do not represent the Swiss population. To create a stratified sample, we exclude two age groups: 0-19 and 65+ as they each included only one policy. For the remaining two age groups (20-39 and 40-64) we recalculate the proportions to represent the proportions of the population as if only these two age groups existed. The new proportions are presented in Table 9.

Table 9: Recalculated proportions for selected age groups for each gender

Age group	Men	Women
20-39	43.5%	43.0%
40-64	56.5%	57.0%

Source: Own work based on EY's dataset (2019).

With the help of the new proportions, the number of policies per each age group and gender is then selected. It should be noted that we do not choose a policy if the salary of that policy was 0 as this indicates that the individual is no longer employed and therefore does not contribute to the pension plan. Because we want the sample to be representative and at the same time as big as possible, we use all policies for the smallest strata, which is women in the age group 40-64. With this initially selected stratum, the number of policies needed in the women's age group 20-39 for the recalculated proportions from Table 9 is calculated. When we have the total number of selected policies for women we calculate the number of policies we need to select for men using the proportions of employed men and women. The number of randomly[26] selected policies by age group and gender and their ratios can be seen in Table 10.

Table 10: Number of policies and proportions by age group for each gender in the selected sample

	Men		*Women*	
Age group	**Number of policies**	**In %**	**Number of policies**	**In %**
20-39	88	43.6%	72	42.9%
40-64	114	56.4%	96	57.1%
Total	***202***	***100.0%***	***168***	***100.0%***

Source: Own work based on EY's dataset (2019).

Finally, the proportion between men and women in our selected sample and the number of policies for each gender is as follows in Table 11.

We end up with a selected sample that comprised of 370 policies. Even though the number of policies in the selected sample decreased by 45% from the original EY's dataset, as can be seen in Table 10 and Table 11, the gender and age group ratios are more representative of the labour force and population, respectively. Nevertheless, the selected sample size is still sufficient to perform a sensitivity analysis.

[26] The policies were randomly selected with the help of an Excel toolset called Ablebit (Ablebits, n.d.).

Table 11: Number of policies and proportions by gender in the selected sample

	Number of policies	**In %**
Men	202	54.6%
Women	168	45.4%
Total	***370***	***100.0%***

Source: Own work based on EY's dataset (2019).

The comparison of descriptive statistics of the original EY's dataset versus the selected sample can be seen in Table 12.

Table 12: Descriptive statistics of the original EY's dataset and the selected sample

Descriptive statistics	**Original dataset**	**Selected sample**
Average age	38.6	41.5
Average obligatory retirement savings (in CHF)	46,004	57,277
Average total retirement savings (in CHF)	80,053	100,893
Average salary (in CHF)	82,273	86,740

Source: Own work based on EY's dataset (2019).

The average age increased from 39 years in the original dataset to 41 years in the selected sample, which is a desired change as the age group 40-64 includes a higher share of the population than the age group 20-39, as shown in Table 6. Since the average age in the selected sample is higher than in the original dataset, it makes sense that the obligatory and total retirement savings increased, because statistical data shows that older people have accumulated more retirement savings. It is also consistent that the average salary increased with average age, as older individuals often have a higher rank and therefore receive a higher salary.

4.4 Benefit valuation tool

The DBO is calculated as follows in equation (3).

$$DBO = TB + RB + SB + DB \tag{3}$$

With:

TB: termination benefits
RB: retirement benefits
SB: survivors' benefits
DB: disability benefits

These benefits are also described in chapter 2.2.1. Some pension funds may also consider the following benefits when calculating the DBO: deferred retirement benefits, early retirement benefits, etc. (Zurich Insurance Company Ltd., 2019). Most funds also deduct risk sharing[27] when evaluating DBO.

For example, let us look at a policy with the following data.

- age: 34,
- sex: male,
- occupational rate: 100%,
- retirement savings: CHF 30,000, and
- AHV salary: CHF 75,000.

Now, let us calculate as many values and benefits of the plan as we can as of today, before needing any kind of sophisticated tool to project future developments and their present value.

- Coordinated salary: CHF 50,115. Calculated as CHF 75,000 − CHF 24,880[28].
- Retirement credit: CHF 3,508. Calculated as CHF 50,115 × 7%[29].
- Retirement savings (movement for one year): CHF 33,808. Calculated as CHF 3,508 + CHF 30,000 × (1+1%[30]).
- Spouse pension: CHF 12,027. Calculated as CHF 50,115 × 24%[31].
- Disability pension: CHF 20,046. Calculated as CHF 50,114 × 40%[31].
- Retirement pension: CHF 0. Calculated as retirement savings multiplied by the conversion rate, but the conversion rate is 0% for retirement before the age of 58.

The calculation after this point becomes more complex. The next step would be to calculate the benefits of equation (3), but for that, we would need the corresponding probabilities (for example turnover probabilities for termination benefits), the projected retirement savings, projected conversion rate, projected interest credit rate, etc. Lastly, we would need to discount the benefits and add them up. Unfortunately, this would give us the DBO for only 1 year (when the policyholder is 34 years old). The DBO has to be calculated for all the future years until the age of 120 and all the past years as well (starting at age 17). Only after this step would we know the DBO for this policy. Since pension funds usually have more

[27] Considered in the Master's thesis is the so-called risk sharing 1.0, which reduces the liability by making an allowance for the fact that employee contributions increase with age (KPMG, 2018).
[28] See chapter 2.2
[29] Retirement credit as in Table 3.
[30] Interest credit rate as in Table 4.
[31] See chapter 4.2.

than one policy, the DBO has to be calculated for all of them. The final DBO would be the sum of all DBOs of individuals policies. To perform the sensitivity analysis, we needed a program that would calculate DBO for any pension plan and actuarial assumptions. EY has generously given me permission to use their Excel file which does exactly that. In this chapter, we will shortly describe how this document (hereafter: valuation tool) derives the DBO; which parameters are needed and how they are calculated.

The first thing the valuation tool requires is for the user to manually input the demographic and financial assumption parameter values they wish to use in deriving the DBO. We entered the parameter values as we described in chapter 4.1. Another parameter that is required by the valuation tool is the AHV pension (see chapter 2.2).

The second component that needs to be entered are the benefit plan's rules and benefits as prescribed in chapters 2.2.1 and 2.2. Included must be:

- retirement credits of the pension scheme (if different than those prescribed by the law),
- employee contributions,
- retirement benefits such as retirement age, spouse pension, child pension, and conversion rate,
- disability benefits such as disability pension, spouse pension, and child pension,
- survivors' benefits such as spouse pension, and child pension,
- BVG retirement credits (see Table 3), and
- BVG conversion rate (see chapter 3.2.5).

The valuation tool then estimates the DBO for each policy from our sample. Below we name factors that play a key role in the calculation of the DBO. For each policy, the factors are calculated for each age between 17 and 120 i.e. the factors' value is evaluated at each age/time, where at time 0 the age is equal to the age of the policy currently being considered. For instance, in our example, we calculated the retirement credits for a person aged 34, so this would be time 0.

The mortality table used is BVG 2015. The probabilities we calculate or procure from the BVG 2015 table (separately for men and women) are:

- (dependent) probability of dying in the active state at the age of x $({}^{*}q^{a}_{x})$,
- probability of dying in the disabled state at the age of x (q^{i}_{x}),
- probability of dying at the age of x (q_{x}),
- (dependent) probability of leaving the active state and becoming disabled within a year at the age of x years $({}^{*}i_{x})$,
- probability of dying at the age of x and being married (w_{x}),
- the average age of a widow/widower (y_{x}),
- probability of dying as a widow/widower at the age of x (q^{w}_{x}), and
- turnover rate (θ_{x}).

The probabilities of leaving the active state can be approximated with equations (4) and (5).

$$^{*}q_x^a \cong q_x^a \cdot (1 - 0.5 \cdot i_x) \tag{4}$$

$$^{*}i_x \cong i_x \cdot (1 - 0.5 \cdot q_x^a) \tag{5}$$

With:

$q^a{}_x$:	probability of dying in the active state at the age of *x* (as in BVG 2015)
i_x:	probability of becoming disabled at the age of *x* (as in BVG 2015)

The raw probabilities are calculated as in equations (6), (7), (8), and (9), according to the publication by the Bundesamt für Statistik and Bundesamt für Sozialversicherungen (2014).

$$q_x = \frac{T_x}{B_x + 0.5 \cdot (E_x - A_x)} \tag{6}$$

With:

T_x:	number of living men/women that die between the ages *x* and *x+1*
B_x:	number of living men/women aged *x*
E_x:	number of newly joined men/women between the ages *x* and *x+1* (i.e. the number of newly joined in the active state, the number of newly joined in the retired state)
A_x:	number of exits of men/women between the ages *x* and *x+1* (i.e. the number of exits from the active state, retirees cannot exit, dying does not count towards exiting)

Similarly, the probability $q^w{}_x$ can be calculated.

The values of w_x and y_x are calculated as follows in equations (7) and (8).

$$w_x = \frac{H_x}{T_x} \tag{7}$$

$$y_x = \frac{Y_x}{H_x} \tag{8}$$

With:

H_x:	number of men/women that were married at the time of death
Y_x:	ages of the widows/widowers added up

Finally, the turnover rate θ_x is calculated as follows in equation (9).

$$\theta_x = \frac{A_x}{B_x^a + 0.5 \cdot (E_x - I_x - T_x^a - P_x)} \tag{9}$$

With:

A_x: number of exits of active men/women between the ages x and $x+1$

B^a_x: number of active men/women aged x

E_x: number of newly active men/women between the ages x and $x+1$

I_x: number of men/women between the ages x and $x+1$ that are newly receiving a disability pension

T^a_x: number of active men/women that die between the ages x and $x+1$

P_x: number of newly retired men/women between the ages x and $x+1$

The next step is to evaluate salary information. Firstly, the AHV pension is calculated according to how we set our social security increase parameter. At time 0 AHV pension is exactly CHF 28,440 (see chapter 2.2). Next, the salary is calculated for each point in time, where the salary increase rate and inflation parameters must be considered.

After all the salary information is obtained, we consider the retirement savings information. Retirement credits until the age of 70 are calculated as coordinated salary multiplied by the retirement credits. Next, the retirement savings are calculated as the sum of retirement credits and retirement savings multiplied by the interest credit rate. The next important factor is service, which refers to how many years an individual made contributions to the pension fund. Service is no longer 0, the next year after the retirement savings are no longer 0 and increases by 1 each year after that. For each age, we also consider retirement savings (plan's and BVG) at the end of the period and accumulated employee contributions.

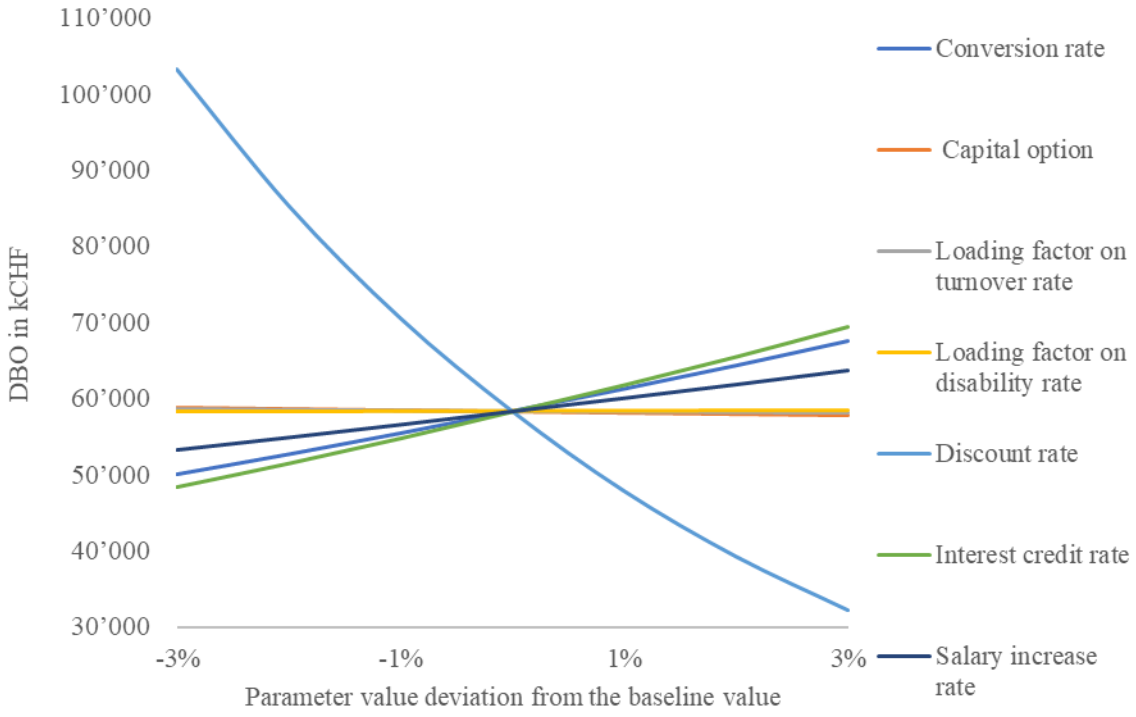
Finally, the different types of benefits needed for equation (3) are calculated for all. After the DBO for each policy is summed up, the result is the DBO of the pension scheme. The benefit valuation tool had a limitation. How EY projects the discount rate and interest credit rate into the future could neither be observed nor changed.

5 RESULTS

In this chapter, we present the results of the sensitivity analyses. The results can also be found in Appendix 2.

Figure 6 shows which actuarial assumption have the greatest impact on the DBO. The assumption that affects the DBO by far the most is the discount rate, followed by the interest credit rate, conversion rate, salary increase rate, capital option, loading factor on turnover rate, and lastly loading factor on disability rate.

Figure 6: How parameter value deviation from the baseline values affects the DBO



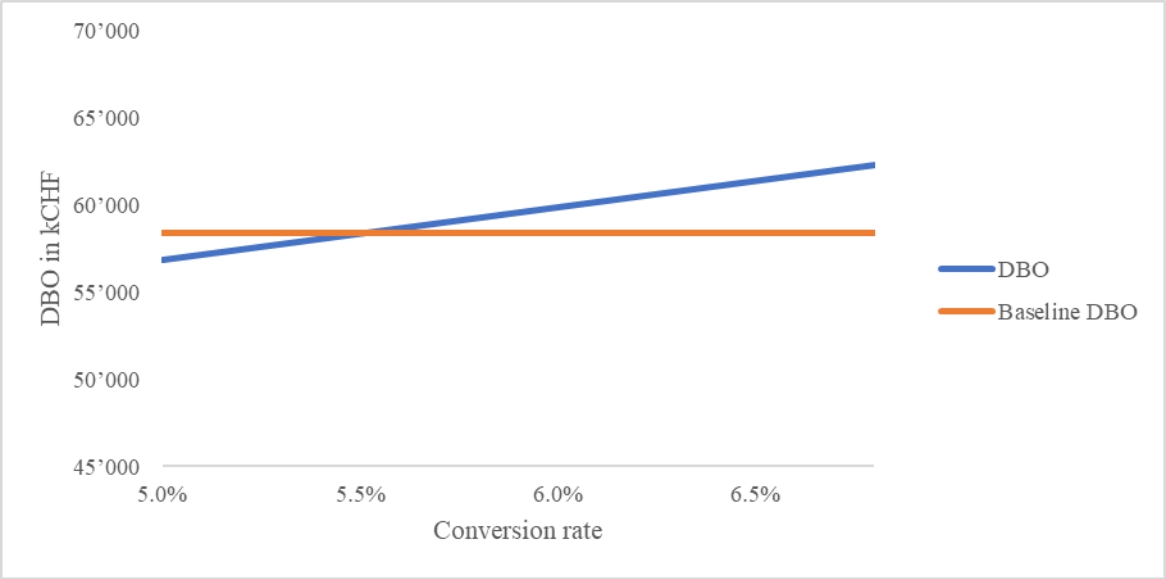
Source: Own work.

However, Figure 6 does not consider the probability of, for example, a 1% parameter value increase occurring for a given assumption. For example, according to our parameter value probability estimates in Table 5, capital option parameter values have a very low probability of deviating by just 1%. It is more likely that they change by 10% or more. We, therefore, calculate a series of sensitivity analyses considering probable parameter values for each actuarial assumption.

5.1 Conversion rate

For the conversion rate, we consider parameter values between 5.0% and the maximum obligatory conversion rate of 6.8%. Our baseline conversion rate value is 5.5%. How the baseline DBO changes in absolute and relative terms are seen in Table 17. In Figure 7 we graphically present how the absolute value of the DBO changes when we change the parameter values of the conversion rate.

Figure 7: DBO for different conversion rates



Source: Own work.

The results show that the maximum obligatory conversion rate increases the baseline DBO by 6.7%, while the lowest conversion rate of 5.0% decreases the baseline DBO by 2.6%. Each 10 basis point (hereafter: bp) increase/decrease of the baseline conversion rate value can, ceteris paribus, lead to an 0.5% increase/decrease of the DBO relative to our baseline DBO.

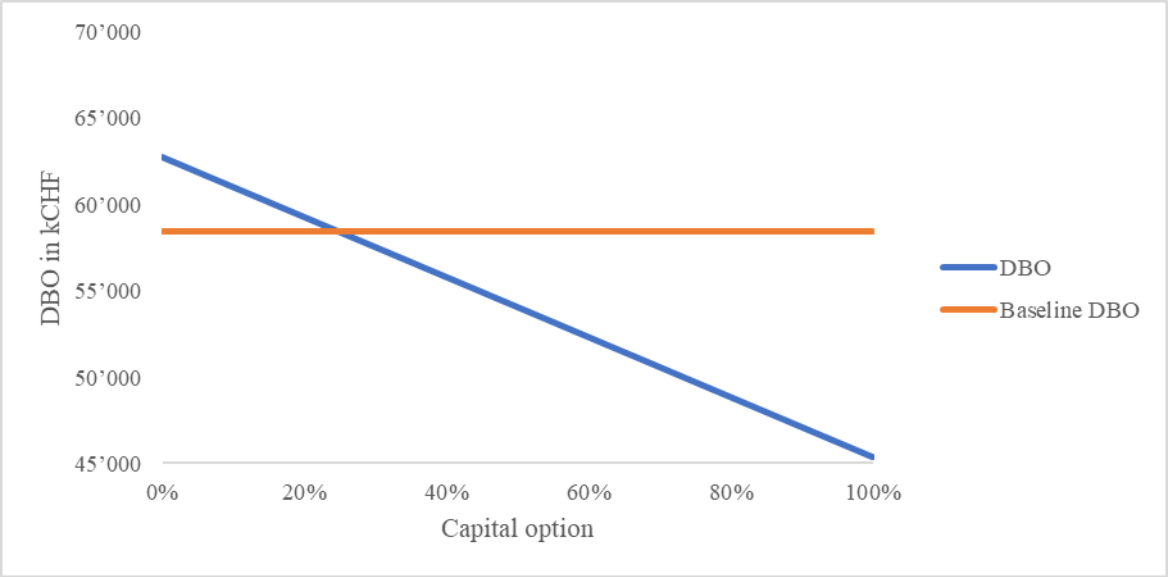
As can be seen the DBO increases with the conversion rate. This is what we expected because we know that the higher the conversion rate the higher the pension that the company has to pay.

5.2 Capital option

For the capital option, we consider the most pessimistic parameter value of 0% and the most optimistic of 100%. We consider as well two in-between values; 10% and 50% and our baseline capital option value is 25% How the baseline DBO changes in absolute and relative terms is seen in Table 18. In Figure 8 we graphically present how the absolute value of the DBO changes when we change the capital option parameter values.

The results show that the pessimistic parameter value of 0%, meaning the company assesses none of their employees will take their pensions as a capital option increases the baseline DBO by 7.4% relative to the most commonly used parameter value of 25%. On the other hand, when the company assesses all their employees will take their pensions as a capital option, the DBO decreases by 22.3% relative to the baseline DBO. Each 10 percentage point increase/decrease of the most commonly used baseline parameter value of 25% can, ceteris paribus, lead to a 3% decrease/increase of the DBO relative to the baseline DBO.

Figure 8: DBO for different capital options



Source: Own work.

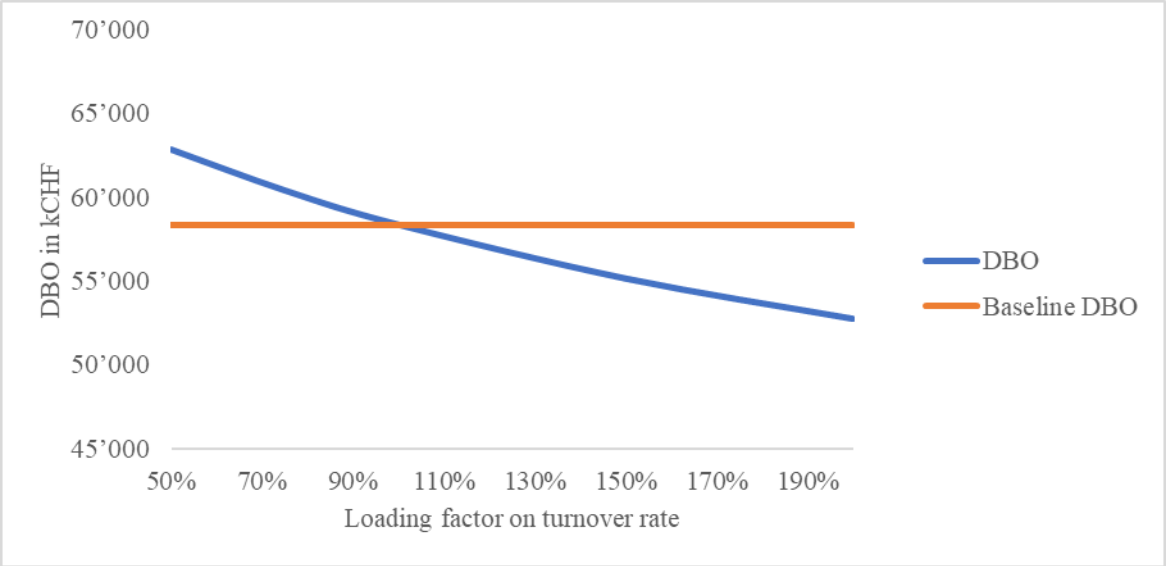
As can be seen, the DBO decreases when we increase the capital option. This is what we expected because setting a high capital option means that fewer individuals want to receive a pension, which means the company has no risk anymore after paying the lump sum and their obligation is therefore lower. Depending on the height of the capital option, the parameter can be considered optimistic from the company's viewpoint. On the other hand, setting a low capital option or even no capital option can be considered a conservative assumption and the longevity risk remains in the company, therefore they need to recognize a higher liability.

5.3 Loading factor on the turnover rate

Loading factors on turnover rate we consider are two higher and two lower than our baseline loading factor value of 100%. How the baseline DBO changes in absolute and relative terms is seen in Table 19. In Figure 9 we graphically present how the absolute value of the DBO changes when we change the loading factor parameter values on the turnover rate.

The results show that when the company evaluates that their turnover rate parameter value is 50% lower than the baseline parameter value (i.e. employees do not leave the company as often), the baseline DBO increases by 7.7%. However, if they evaluate that their employees leave 2 times as often, then the baseline DBO decreases by 9.6%.

Figure 9: DBO for different loading factors on the turnover rate



Source: Own work.

The increases and decreases of the loading factor parameter value for the turnover rate are noticeably not linear. A 10 percentage point decrease in the baseline turnover rate can, ceteris paribus, lead to an increase between 1.4% and 1.5% of the DBO. A 10% increase can, however, ceteris paribus, lead to a decrease between 1.0% and 1.1% of the DBO. The bigger the increase in the loading factor parameter value on the turnover rate, the smaller the relative change in DBO is, which we can tell because the change in baseline DBO for loading factor 200% is not twice as big as the change for loading factor 150%.

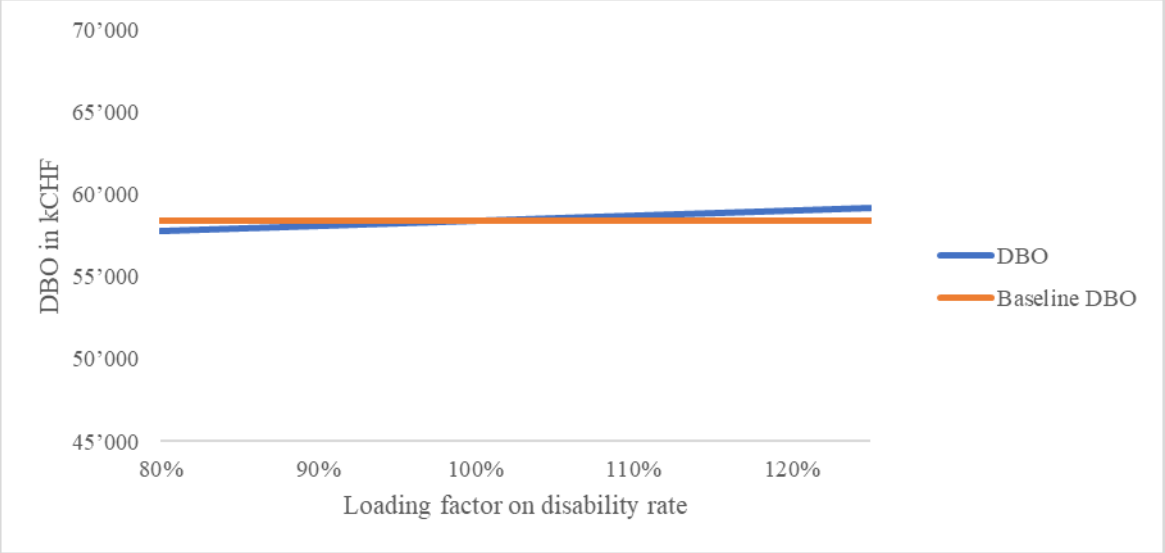
As can be seen, the DBO decreases when we increase the loading factor on the turnover rate. This is what we expected, because if the probability that an employee will leave the company increases, the company's obligation to pay them a pension disappears.

5.4 Loading factor on disability rate

For loading factors on disability rate, we consider four other loading factors parameter values. How the baseline DBO changes in absolute and relative terms are seen in

Table 20. In Figure 10 we graphically present how the absolute value of the DBO changes when we change the loading factor parameter values on disability rate.

Figure 10: DBO for different loading factors on disability rate



Source: Own work.

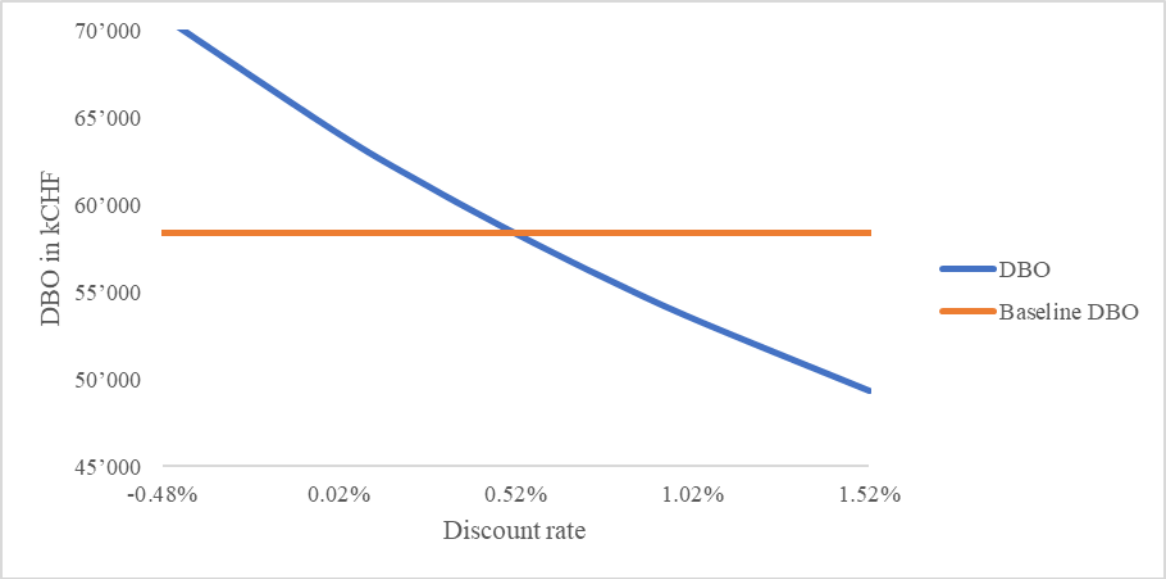
The results show that the when the company evaluates that their disability rate is lower than the baseline disability rate (i.e. employees do not leave the active state and enter the disability state as often), the baseline DBO decreases by 1.0%. However, if they evaluate that their employees become disabled easier, then the baseline DBO increases by 1.3%. A 10 percentage point increase/decrease of the 100% loading factor parameter value can, ceteris paribus, lead to an 0.5% increase/decrease in the DBO relative to the baseline DBO.

As can be seen, the DBO increases when we increase the loading factor parameter value on the disability rate. This is what we expected because if we increase the probability of an individual becoming disabled, the obligation increases as well.

5.5 Discount rate

For the discount rate, we consider relative changes to the discount rate parameter values rather than absolute as with other actuarial assumptions, because the baseline discount rate value of 0.52% changes every quarter. How these value changes affect the baseline DBO in absolute and relative terms is seen in Table 21. In Figure 11 we graphically present how the absolute value of the DBO changes when we change the discount rate parameter values.

Figure 11: DBO for different discount rates



Source: Own work.

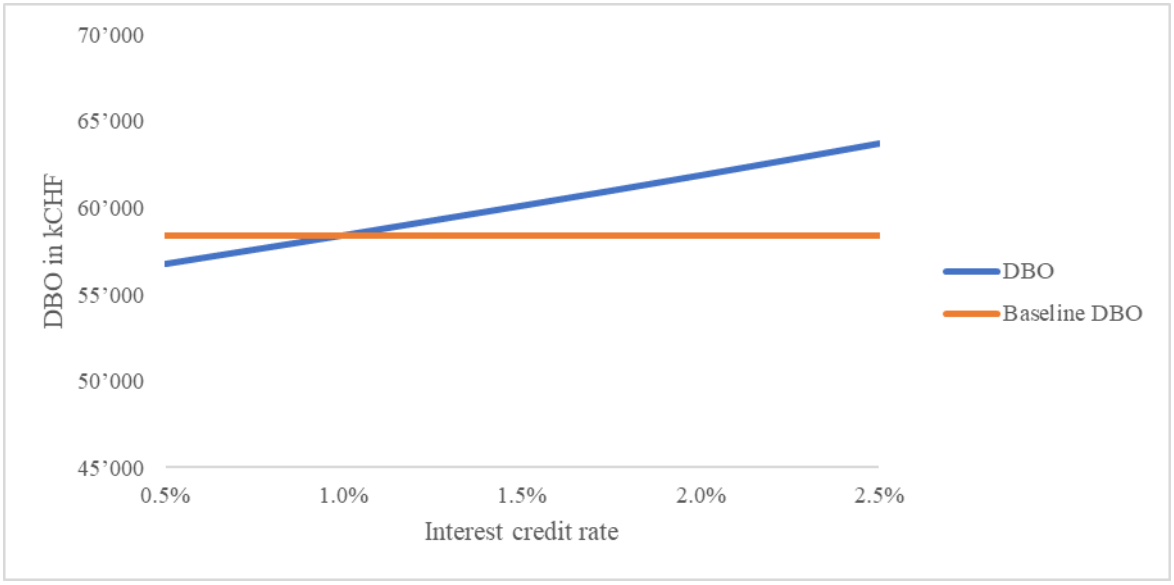
We notice a couple of things in our results. Firstly, the change in the baseline DBO is not linear. While a 10bp discount rate parameter value increase or decrease leads to the same 1.8% relative change in the baseline DBO, that is not true for other discount rate parameter value increases/decreases. Secondly, we notice that when we increase the discount rate parameter value by more than 10bp, the relative change in the baseline DBO slows down. While when we decrease the discount rate parameter value by more than 10bp, the relative change in the baseline DBO gets faster. Lastly, we note that decreasing the discount rate parameter value has a bigger effect on the baseline DBO than increasing the discount rate parameter value. A 10bp discount rate parameter value increase can, ceteris paribus, lead to a DBO decrease between 1.5% and 1.8%. A 10bp discount rate parameter value decrease can, ceteris paribus, lead to a DBO increase between 1.8% and 2.1%.

The result seen above is what we predicted, that is that the DBO decreases when we increase the discount rate parameter value. That is of course because the DBO is discounted using this rate and if it is higher, the DBO becomes smaller.

5.6 Interest credit rate

For the interest credit rate, we consider parameter values between 0.5% and 2.5%. Our baseline interest credit rate value was 1.0%. How the baseline DBO changes in absolute and relative terms is seen in Table 22. In Figure 12 we graphically present how the absolute value of the DBO changes when we change the interest credit rate parameter values.

Figure 12: DBO for different interest credit rates



Source: Own work.

The results show that using a very high interest credit rate parameter value of 2.5% increases the baseline DBO by 9.1% while using a low interest credit rate parameter values, such as 0.5%, decreases the baseline DBO by 2.8%. Each 10bp increase/decrease of the baseline interest credit rate parameter value can, ceteris paribus, lead to an 0.6% increase/decrease in the DBO relative to the baseline DBO.

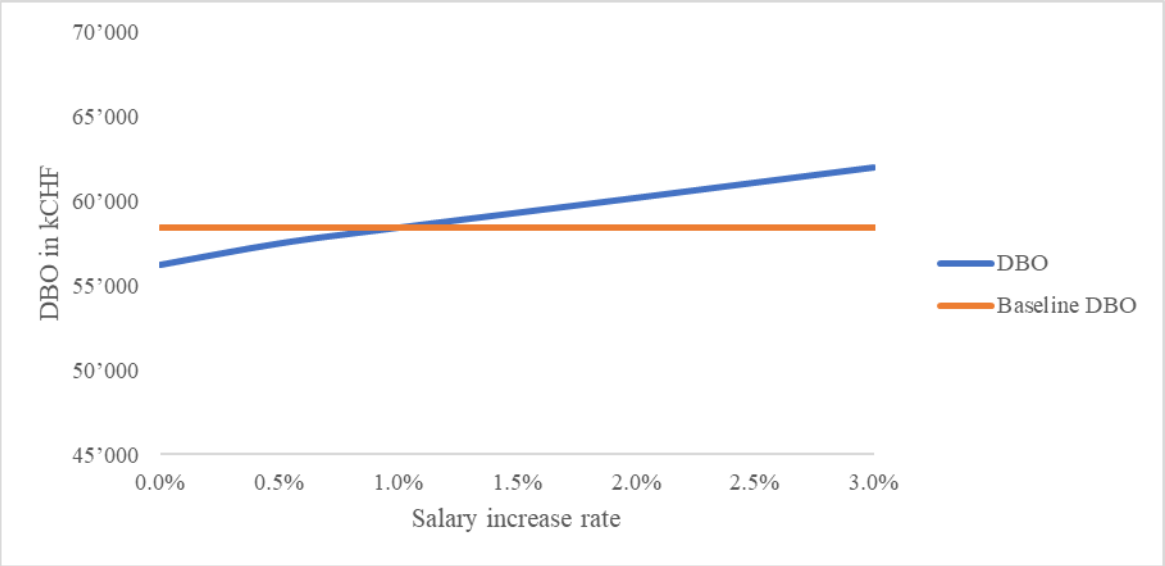
The DBO rises when the interest credit rate parameter value increases. This result is what we expected because the pension fund has a higher liability if the interest rate is higher.

5.7 Salary increase rate

For the salary increase rate, we consider parameter values between 0% and 3%. Our baseline salary increase rate parameter value is 1.0%. How the baseline DBO changes in absolute and relative terms are seen in Table 23. In Figure 13 we graphically present how the absolute value of the DBO changes when we change the salary increase rate parameter value.

The results show that using a very high salary increase rate parameter value of 3% increases the baseline DBO by 6.1% while using a low salary increase rate parameter value, such as 0%, decreases the baseline DBO by 3.8%. Each 10bp increase/decrease of the baseline salary increase rate can, ceteris paribus, lead to an 0.3% increase/decrease in the DBO relative to the baseline DBO.

Figure 13: DBO for different salary increase rates



Source: Own work.

The DBO rises when the salary increases rate parameter value increases. This result is expected because if the company sets a higher salary increase rate it increases its obligation to provide a higher salary.

5.8 Overview of results

In this part, we summarize the results of individual sensitivity analyses and comment on them. The overview of the results is presented in Table 13.

As per our results, the biggest difference in the DBO may occur when we change the capital option parameter. The second biggest change in the DBO may arise when changing the value of the discount rate, followed by the loading factor on the turnover rate. All the other assumptions change the DBO by roughly the same percentage when the parameter values change, with the lowest change in DBO occurring with the salary increase rate.

As we have mentioned briefly in the introduction even the lowest change in the DBO can have consequences that differ from company to company. For example, if we imagine a company with a lower amount of SAD, meaning a big misstatement may have a significant impact on its financial statement because SAD is a threshold below which identified differences are considered to be material. A small change in the DBO due to an inaccurately set parameter may lead to differences above the SAD threshold and therefore may be material from an audit perspective. The company would then be forced to review their accounts one more time. On the other hand, a company with a high SAD amount may not be as sensitive even to higher differences in the DBO.

Table 13: Overview of results

Assumption	Baseline parameter value	Change in the parameter value	Change in DBO
Conversion rate	5.5%	+ 10bp	+ 0.5%
		- 10bp	- 0.5%
Capital option	25%	+ 10%	- 3.0%
		- 10%	+ 3.0%
Loading factor on turnover rate	100%	+ 10%	- 1.1%
		- 10%	+ 1.5%
Loading factor on disability rate	100%	+ 10%	+ 0.5%
		- 10%	- 0.5%
Discount rate	0.52%	+ 10bp	- 1.8%
		- 10bp	+ 2.1%
Interest credit rate	1.0%	+ 10bp	+ 0.6%
		- 10bp	- 0.6%
Salary increase rate	1.0%	+ 10bp	+ 0.3%
		- 10bp	- 0.3%

Source: Own work.

Our overview table may also give an indication which incorrectly set assumptions may be easier or harder to spot. As we have mentioned before some managers have the incentive to lower the company's DBO because the amount of the DBO influences the net defined benefit liability/asset which is recognized in the financial statements. For example, if a company with a high amount of SAD would want to lower their net defined benefit liability/asset by lowering their DBO they might try to increase the capital option parameter. Let us say that the true capital option parameter of the company is 20%, but the management decides to use 30% instead. That ultimately lowers the DBO by 3% and the net defined benefit liability/asset while having no consequences since SAD is large. In the end, the liabilities in the financial statement decrease and the management achieved their goal.

5.8.1 A practical example

Entity A provides its pension valuation report for review by EY's actuarial team. The actuarial assumptions used for the valuation of the DBO are as in Table 14. Entity A calculated the DBO based on these parameter values to be kCHF 12,664.

Most of the reported parameter values are reasonable or within a reasonable range, as per Table 5. But the EY team notices that the loading factor on the disability rate and the discount rate parameter value used by entity A are out of range (at December 31, 2018 the discount

rate used should have been below 1.0% for durations below 20 years (Schweizerische Kammer der Pensionskassen-Experten, 2019)), so they decided to do a sensitivity analysis.

Table 14: Actuarial assumption parameter values example

	Baseline parameter values
Demographic assumptions	
Mortality rate	BVG 2015 Menthonnex
Loading factor and disability rate	50% BVG 2015
Loading factor and turnover rate	125% BVG 2015
Capital option	20%
Conversion rate	5.5%
Financial assumptions	
Discount rate 31.12.2018 (for a duration of 17.9 years)	1.2%
Interest credit rate	1.0%
Inflation	1.0%
Salary increase rate	0.5%

Source: Own work based on Kuhn (2019).

To judge if a 1% increase or decrease in the parameter value is critical they use results from Table 13 to determine the change in the DBO and the audit team provides them with the SAD amount which was kCHF 192.5. In Table 15 EY calculates how the amount of the DBO changes and if that change is bigger than the SAD amount and therefore critical.

All the assumptions except the capital option and the loading factors on the disability and turnover rate are deemed as critical, but, as mentioned at the beginning of chapter 5, the assumptions that do not prove to be critical are those that are unlikely to change by just 1 percentage point. Furthermore, EY calculates the so-called switching value for each assumption, which is the parameter value that an assumption would have to take for the change in the DBO to be equal to the SAD amount.

For example, the switching value for the conversion rate is calculated as in equation (10).

$$\text{switching value} = \left(5.5\% + \frac{SAD}{DBO} \times \frac{0.1\%}{-0.5\%}\right) \times 100 \qquad (10)$$

Table 15: Sensitivity analysis example

Parameter	Variation of the DBO due to a ±1% variation in kCHF[32]	Criticality judgement
Conversion rate	633.2	critical
Capital option	38.0	not critical
Loading factor on turnover rate	13.9	not critical
Loading factor on disability rate	6.3	not critical
Discount rate	2,279.5	critical
Interest credit rate	759.8	critical
Salary increase rate	379.9	critical

Source: Own work.

Table 16: Switching values example

Parameter	Switching value	Increase/decrease from baseline values
Conversion rate	5.2%	-0.30%
Capital option	15%	-5%
Loading factor on turnover rate	111%	-14%
Loading factor on disability rate	80.4%	+30.4%
Discount rate	1.1%	-0.08%
Interest credit rate	1.3%	+0.25%
Salary increase rate	1.0%	+0.51%

Source: Own work.

[32] For the discount rate and loading factor on turnover rate a 1% increase in the parameter value does not lead to the same variation in the DBO than a 1% decrease, we have therefore used the conservative smaller variation in the DBO.

The switching values for the discount rate and the loading factor on the disability rate tell us that a discount rate parameter value above 1.1% and a loading factor value below 80.4% will result in a change in the DBO bigger than the amount of SAD.

EY's final remark is that entity A's loading factor on disability rate should be at least 85%, which is the lowest end of actuarial practice. A 35 percentage point increase would increase the DBO by 2%. Furthermore, the discount rate should be at least 0.25% lower, which would increase the DBO by 5%. Entity A's liabilities have to increase.

The concern that remains when investigating DBOs and financial statements is therefore how to prevent the misuse of actuarial assumptions as it would be theoretically possible to lower the net defined benefit liabilities by modifying multiple parameters before going over the material threshold. The sensitivity analyses were performed by always changing only one actuarial assumption while holding the parameter values of other assumptions constant. This is, of course, unlikely to occur in practice because assumptions may be correlated. To study the correlation of assumptions we perform 3 additional sensitivity analyses of 3 probable correlated scenarios.

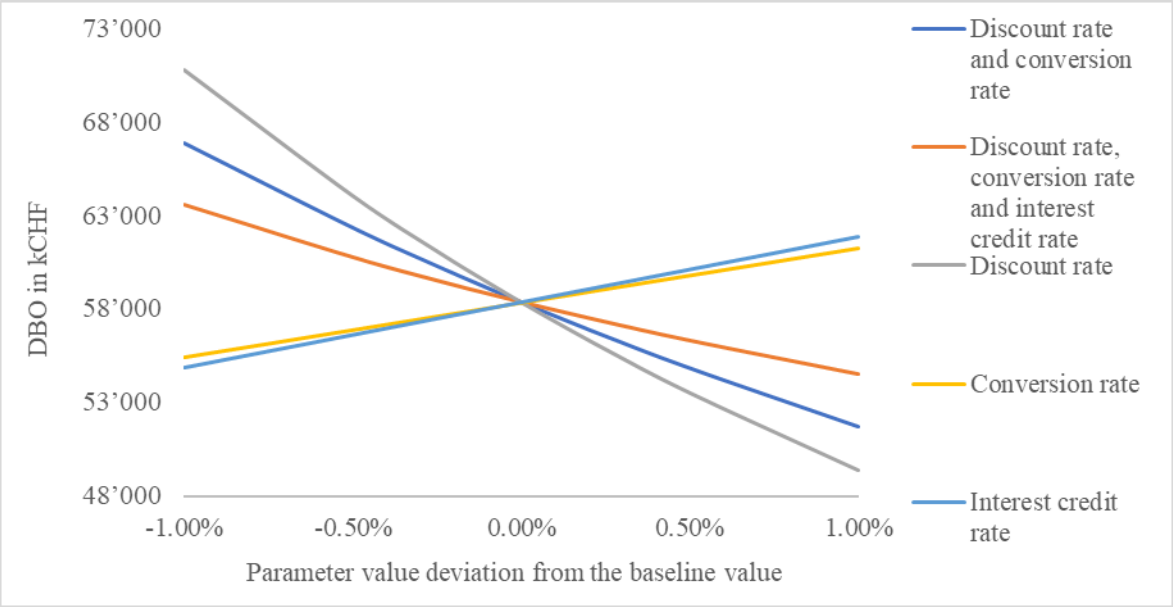
5.8.2 Conversion rate, discount rate, and interest credit rate

The first scenario we consider is the correlation between the conversion rate and the discount rate. The sensitivity analysis is for a positive correlation between the assumptions i.e. if the discount rate decreases then so does the conversion rate. The idea behind the scenario is that if the discount rate decreases, so should the conversion rate to reflect the market (Kuhn, 2019). Since the conversion rate parameter values are unlikely to increase, as mentioned in chapter 3.2.5, the only possible situation where both the conversion rate and the discount rate increase is when an entity switches to a new pension scheme. The results of the sensitivity analysis can be found in Table 24.

The second scenario considers the interest credit rate additionally to the conversion rate and the discount rate. The interest credit rate is also in a positive correlation to the other two assumptions. The results can be found in Table 25. The baseline values for all the assumptions are identical to that of Table 4.

Figure 14 shows which correlated scenario impacts DBO the most. For comparison, we also add the uncorrelated results of the conversion rate, the discount rate, and the interest credit rate (see chapter 5.8 or Appendix 2) to the figure. As per Table 13, it is known that a decrease in the conversion rate decreases the DBO, a decrease in the discount rate increases the DBO, and a decrease in the interest credit rate decreases the DBO and the other way around. Discount rate clearly affects DBO more than when combined with the conversion rate and the interest credit rate, since the DBO still increases compared to the baseline DBO when the parameter values of all the assumptions decrease. Although the increase is not as big as compared to considering only the discount rate assumption.

Figure 14: DBO for correlated scenarios between discount rate, conversion rate, and interest credit rate



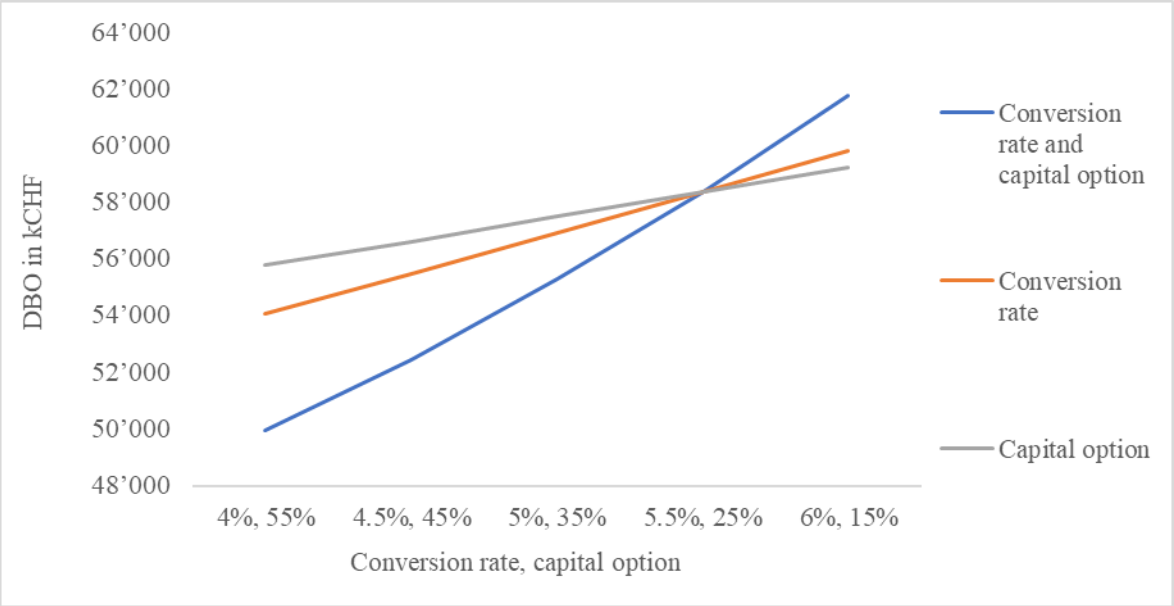
Source: Own work.

5.8.3 Conversion rate and capital option

The third scenario considers the correlation between the conversion rate and the capital option. The correlation between these assumptions is negative i.e. if the conversion rate decreases the capital option increases. The idea is that as conversion rates decrease retirement savings become smaller so more people entering retirement choose the capital option instead of a pension (Kuhn, 2019). For every 0.5 percentage point decrease in the conversion rate parameter value, we assumed a 10 percentage point capital option parameter value increase. The results can be seen in Table 26.

Figure 15 shows how the correlated scenario affects the DBO. For comparison, we also add the uncorrelated results of the conversion rate and the capital option (see chapter 5.8 or Appendix 2) to the figure. As per Table 13, it is known that a decrease in the conversion rate decreases the DBO and a decrease in the capital option increases the DBO and the other way around. The correlated scenario lowers the DBO far more than both the assumptions individually.

Figure 15: DBO for correlated scenario between conversion rate and capital option



Source: Own work.

CONCLUSION

The Master's thesis addresses pension accounting under IAS 19 in Switzerland. Pension accounting is a broad research topic because several factors need to be considered. Among those factors are accounting regulations such as IAS 19 and assumptions made when valuing pension liabilities.

Switzerland is chosen as the country on which the Master's thesis focuses because its large and complex pension system ranks high among the other European countries. From its three-pillar system, the Master's thesis focuses on the second pillar, the so-called occupational pension schemes, under which the law provides minimum benefit requirements to the individuals in a working relationship.

Accounting standard IAS 19 regulates employee benefits accounting. In the Master's thesis, we focus on post-employment benefits, which are benefits payable after the end of employment such as pensions. Post-employment benefits can be classified as either defined contribution plans or defined benefit plans. In defined contribution plans the company pays a specified amount of contributions into a pension fund and therefore the company does not carry any actuarial and investment risk. On the other hand, in defined benefit plans the company promises to provide certain agreed benefits to its employees and therefore carries the risks. The obligations from defined benefit plans need to be discounted to determine the present value and to measure the obligation actuarial assumptions are also necessary. In the Master's thesis, we study only defined benefit plans because in Switzerland basically all pension plans are categorized as defined benefit plans.

The value that represents the present value of benefits that a company promised its employees is the DBO. In the statement of financial position, the net defined benefit liability/asset must be recognized, which is the difference between the present value of the DBO and the fair value of plan assets. This difference can either be a deficit if the present value of the DBO is larger than the fair value of plan assets, or a surplus if the present value of the DBO is smaller than the fair value of plan assets but adjusted by the asset ceiling. The present value of the DBO must be determined using the PUC method, where each period of service gives rise to an additional unit of benefit entitlement. The DBO can also change when actuarial assumptions change, which can result in actuarial gains and losses. Actuarial gains and losses can generally be categorized as gains or losses from demographic assumptions, from financial assumptions, and from experience.

When a company promises to pay a certain amount of benefits to its employees, the timing and duration of these benefits are not certain, therefore the actuary must make assumptions about future events. They are a company's best estimate of the variables that will determine the ultimate cost of providing post-employment benefits. The actuarial assumptions are divided into two categories: demographic assumptions and financial assumptions.

Demographic assumptions are important to determine when the promised benefits will be paid and how the population is changing. To determine the life expectancy of employees the company needs the mortality rate assumption, which is set by choosing a certain mortality table and mortality improvement, which adds the assumption how the population will change in the future. Companies can also provide special benefits, such as if the employee becomes disabled or they leave the company, in which case the company needs to choose the disability and turnover rate. These rates are usually included in the standard tables, but if the company wants to adjust the rates to better represent the company's rates, a fixed percentage, called a loading factor, is applied to the standard tables. The company must also assess what percentage of their employees will use the capital option at retirement. In Switzerland, the conversion rate must be determined as well because the retirement savings are multiplied by this rate.

Financial assumptions are important to project the number of benefits that the company promised. The first financial assumption is the discount rate, which is used to determine the present value of the DBO. The discount rate is set by reference to market yields at the end of the reporting period on HQCB. The next financial assumption is the interest credit rate, which is also used to determine the value of the DBO. The inflation rate assumption is used to determine other financial assumptions. The salary increase rate is used to project an employee's future salary. The social security increase rate measures the annual expected increase of the Swiss first pillar. Finally, the pension increase rate is used to project an employee's future pension.

The goal of the Master's thesis is to perform a sensitivity analysis on the DBO on a test dataset of policies for a typical Swiss pension plan. Since companies have some flexibility

when choosing parameter values of actuarial assumptions, the Master's thesis' results show how different parameter values impact the DBO. Our research questions were:

- How does the DBO change if we use a different parameter value for an actuarial assumption?
- Is the increase/decrease of the DBO in line with our expectations and predictions?
- Which assumptions have the largest effect on the DBO?

For our sensitivity analysis we focused on how the following parameters impact the DBO:

- conversion rate,
- capital option,
- loading factor on the turnover rate,
- loading factor on the disability rate,
- discount rate,
- interest credit rate, and
- salary increase rate.

For our baseline parameter values, we used the most common values that occur in the Swiss market.

The benefit pension plan used is representative of a typical Swiss pension plan. Our test dataset of policies is chosen to represent the Swiss working population by gender and the Swiss overall population by age. The valuation tool used to perform the sensitivity analysis calculated the DBO for our chosen feasible parameter values, pension plan, and dataset. The valuation tool calculates the DBO as the sum of termination benefits, retirement benefits, survivors' benefits, and disability benefits over the ages 17-120.

The results of the sensitivity analysis reveal how the DBO changes. A 10bp increase/decrease in the conversion rate may increase/decrease the DBO by 0.5%. A 10% increase/decrease in the capital option may decrease/increase the DBO by 3.0%. A 10% increase in the loading factor on the turnover rate may decrease the DBO by 1.1%, while a 10% decrease may increase the DBO by 1.5%. A 10% increase/decrease in the loading factor on the disability rate may increase/decrease the DBO by 0.5%. A 10bp increase in the discount rate may decrease the DBO by 1.8%, while a 10bp decrease may increase the DBO by 2.1%. A 10bp increase/decrease in the interest credit rate may increase/decrease the DBO by 0.6%. A 10bp increase/decrease in the salary increase rate may increase/decrease the DBO by 0.3%.

The results are in line with our expectations and the biggest difference in the DBO is caused by the change in the capital option parameter values, followed by the discount rate, and the loading factor on the turnover rate. The effect on the DBO is the smallest when the salary

increases rate parameter value changes. However even the smallest change may have adverse effects, but that effect can only be judged on a company to company basis.

As a final remark, we present a practical example of how the results of all the sensitivity analyses can be used in practice and calculate three additional sensitivity analyses showing the impact of correlated assumptions on the DBO.

As the world demographic is rapidly changing, pension accounting should reflect these changes. Companies should as well be held accountable when choosing financial assumptions, as these also reflect in pension accounting. To conclude, the Master's thesis contributes to a better understanding of how the DBO is affected by actuarial assumptions.

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APPENDIXES

Appendix 1: Povzetek (Summary in the Slovene language)

Magistrsko delo proučuje mednarodni računovodski standard 19, ki ureja zaslužke zaposlencev. V delu sem se osredotočila na pozaposlitvene zaslužke, kar so prejemki po koncu zaposlitve, kot so na primer pokojnine. Pozaposlitveni zaslužki se lahko razvrstijo kot programi z določenimi prispevki ali kot programi z določenimi zaslužki. V programih z določenimi prispevki podjetje vplača določen znesek v pokojninski sklad in zato ni izpostavljeno aktuarskemu in naložbenemu tveganju. Po drugi strani pa podjetje v programih z določenimi zaslužki obljubi, da bo zagotovilo dogovorjene zaslužke za svoje zaposlene in tako nosi aktuarsko in naložbeno tveganje. Obveznosti za programe z določenimi zaslužki je treba diskontirati za določitev sedanje vrednosti in za merjenje obveznosti so potrebne tudi aktuarske predpostavke. V magistrskem delu torej proučujem samo programe z določenimi zaslužki, ker delodajalec nosi tveganja in ker so v Švici praktično vsi pokojninski načrti programi z določenimi zaslužki. Podjetja, ki svojim zaposlenim obljubljajo določene zaslužke, morajo upoštevati, kakšna bo sedanja vrednost teh prihodnjih zaslužkov. Ta vrednost se imenuje tudi obveznost za določene zaslužke.

Magistrsko delo se osredotoča na Švico, saj se njen pokojninski sistem uvršča visoko med drugimi evropskimi državami. Njen pokojninski sistem sestavljajo trije stebri, vendar se v delu osredotočim samo na drugi steber, kjer zakon določuje minimalne pogoje za ljudi v službenem razmerju.

Kadar podjetje obljubi, da bo zaposlenim zagotovilo določene zaslužke, čas in trajanje izplačila teh zaslužkov nista znana, zato mora aktuar določiti predpostavke o gibanju prihodnih denarnih tokov. Te predpostavke predstavljajo najboljšo oceno spremenljivk, ki bodo določile končne stroške zagotavljanja pozaposlitvenih zaslužkov. Aktuarske predpostavke so razdeljene v dve kategoriji: demografske predpostavke in finančne predpostavke.

Demografske spremembe predstavljajo velik izziv za vse razvite države, zlasti kar zadeva njihove pokojninske sisteme. S staranjem prebivalstva bo treba pokojnine izplačevati za daljša obdobja. To vpliva na podjetja, saj so svojim zaposlenim obljubila pozaposlitvene zaslužke. Če ne upoštevajo demografskih sprememb, lahko podcenijo količino zaslužkov, ki jih bodo morali zagotoviti v prihodnosti. Demografske predpostavke so pomembne za določitev, kdaj bodo obljubljeni zaslužki izplačani in kako se prebivalstvo spreminja. Za določitev pričakovane življenjske dobe zaposlenih potrebuje podjetje predpostavko o stopnji umrljivosti, ki je določena z izbiro tablice umrljivosti in izboljšavo smrtnosti, ki pove, kako se bo prebivalstvo v prihodnje spreminjalo. Podjetja lahko zagotavljajo tudi posebne zaslužke, na primer, če postane delavec invalid ali zapusti podjetje. V tem primeru mora podjetje izbrati stopnjo invalidnosti in stopnjo fluktuacije. Podjetje mora oceniti tudi, kolikšen odstotek zaposlenih bo pokojnino prevzel v enem znesku, kar se imenuje kapitalska opcija. V Švici je treba določiti tudi menjalno stopnjo, saj se pokojninski prihranki pomnožijo s to vrednostjo.

Pokojnine so prav tako odvisne od finančnih predpostavk, kot so diskontna stopnja, inflacija, povišanja plač in druge. Podjetja morajo ustrezno izbrati te predpostavke za vrednotenje njihovih obveznosti za določene zaslužke. Na primer, če je diskontna stopnja previsoka, se podjetju zmanjša obveznost. Ustrezna izbira predpostavk je zaradi tega pomembna. Finančne predpostavke so pomembne za ocenitev zaslužkov, ki jih je podjetje obljubilo. Prva finančna predpostavka je diskontna stopnja, ki se uporablja za določitev sedanje vrednosti obveznosti za določene zaslužke. Naslednja finančna predpostavka je obrestna mera, ki se prav tako uporablja za določitev sedanje vrednosti obveznosti za določene zaslužke. Predpostavka o stopnji inflacije se uporablja pri določanju vrednosti drugih finančnih predpostavk. Stopnja rasti plač se uporablja za ocenitev prihodnje plače zaposlenega. Stopnja povečanja socialne varnosti meri letno pričakovano povečanje švicarskega prvega stebra. Nazadnje, stopnja povečanja pokojnine se uporablja za ocenitev prihodnje pokojnine zaposlenega.

Namen magistrskega dela je proučiti, kako se obveznosti za določene zaslužke spremenijo, ko se spremeni ena demografska ali finančna predpostavka. Cilj magistrskega dela je izvesti analizo občutljivosti na obveznostih za določene zaslužke na testnem vzorcu polic za tipični švicarski pokojninski načrt. Analiza občutljivosti v pričujočem delu vedno temelji na spremembi samo ene aktuarske predpostavke, za ostale predpostavke pa predpostavi, da so konstante. Rezultati analize občutljivosti pokažejo, kako velik je lahko učinek na obveznosti za določene zaslužke, če se ena predpostavka spremeni. Cilj magistrskega dela ni odgovoriti na vprašanje, ali je učinek na obveznosti dober ali slab, ugotoviti poskušamo samo, za koliko odstotkov se obveznost lahko spremeni.

Raziskovalna metodologija obsega teoretični in empirični del. Teoretični del je sestavljen iz treh poglavij. Prvo poglavje opisuje mednarodni računovodski standard 19 in obveznosti za določene zaslužke. Drugo poglavje opiše švicarski pokojninski sistem. Tretje poglavje se nanaša na aktuarske predpostavke. Ta del služi kot osnova za razumevanje empiričnega dela.

Empirični del je sestavljen iz dveh poglavij. V prvem poglavju sem opisala, katere predpostavke sem vključila v analizo, podrobnosti švicarskega pokojninskega načrta, ki je bil uporabljen, kako je bil izbran testen vzorec podatkov in kako deluje orodje za izračun obveznosti za določene zaslužke ter kako smo ga prilagodili našim podatkom. V drugem poglavju predstavim rezultate iz analize občutljivosti in opišem, kakšen vpliv ima vsaka predpostavka, na koncu pa naredim tri dodatne analize, ko so spremenljivke povezane.

Rezultati iz empiričnega dela odgovarjajo na naslednja vprašanja:

- Kako se obveznost za določene zaslužke spremeni, če spremenimo eno aktuarsko predpostavko?
- Ali je povečanje/zmanjšanje obveznosti za določene zaslužke v skladu z našimi pričakovanji?
- Katere predpostavke imajo največji učinek na obveznosti za določene zaslužke?

Kako se spreminjajo obveznosti za določene zaslužke, je opisano v nadaljevanju. Povečanje/zmanjšanje menjalne stopnje za 10 bazičnih točk lahko poveča/zmanjša obveznosti za določene zaslužke za 0,5 %. 10-odstotno povečanje/zmanjšanje kapitalske opcije lahko zmanjša/poveča obveznosti za določene zaslužke za 3,0 %. 10-odstotno povečanje faktorja na stopnjo fluktuacije lahko zmanjša obveznosti za določene zaslužke za 1,1 %, 10-odstotno zmanjšanje pa lahko poveča obveznosti za določene zaslužke za 1,5 %. 10-odstotno povečanje/zmanjšanje faktorja na stopnjo invalidnosti lahko poveča/zmanjša obveznosti za določene zaslužke za 0,5 %. Zvišanje diskontne stopnje za 10 bazičnih točk lahko zmanjša obveznosti za določene zaslužke za 1,8 %, zmanjšanje za 10 bazičnih točk pa lahko poveča obveznosti za določene zaslužke za 2,1 %. Povečanje/znižanje obrestne mere za 10 bazičnih točk lahko poveča/zmanjša obveznosti za določene zaslužke za 0,6 %. Povečanje/zmanjšanje stopnje rasti plač za 10 bazičnih točk lahko poveča/zmanjša obveznosti za določene zaslužke za 0,3 %.

Rezultati so v skladu z našimi pričakovanji in največja razlika v obveznostih za določene zaslužke je posledica spremembe predpostavke kapitalske opcije, ki ji sledita predpostavka o diskontni stopnji in faktor na stopnjo fluktuacije. Učinek na obveznosti za določene zaslužke je najmanjši pri predpostavki o stopnji rasti plač. Toda tudi najmanjša sprememba ima lahko materialne posledice, vendar se morajo te posledice določiti za vsako podjetje posebej.

Ker se svetovna populacija hitro spreminja, se morajo te spremembe odražati pri izračunu pokojnin. Prav tako morajo biti podjetja odgovorna tudi pri izbiri finančnih predpostavk, saj se tudi te predpostavke odrazijo pri računovodenju. Za zaključek, magistrsko delo prispeva k boljšemu razumevanju, kako aktuarske predpostavke vplivajo na obveznosti za določene zaslužke.

Appendix 2: Sensitivity analyses results

Table 17: Conversion rate sensitivity analysis results

Conversion rate	DBO in kCHF	Change in DBO
5.0%	56,860	-2.6%
5.5%	***58,370***	***0.0%***
6.0%	59,879	2.6%
6.5%	61,388	5.2%
6.8%	62,293	6.7%

Source: Own work.

Table 18: Capital option sensitivity analysis results

Capital option	DBO in kCHF	Change in DBO
0%	62,714	7.4%
10%	60,976	4.5%
25%	***58,370***	***0.0%***
50%	54,025	-7.4%
100%	45,337	-22.3%

Source: Own work.

Table 19: Loading factor on turnover rate sensitivity analysis results

Loading factor on the turnover rate	DBO in kCHF	Change in DBO
50%	62,848	7.7%
75%	60,411	3.5%
100%	***58,370***	***0.0%***
150%	55,156	-5.5%
200%	52,753	-9.6%

Source: Own work.

Table 20: Loading factor on disability rate sensitivity analysis results

Loading factor on disability rate	DBO in kCHF	Change in DBO
80%	57,758	-1.0%

table continues

Table 20: Loading factor on disability rate sensitivity analysis results (cont.)

85%	57,911	-0.8%
90%	58,064	-0.5%
100%	***58,370***	***0.0%***
125%	59,128	1.3%

Source: Own work.

Table 21: Discount rate sensitivity analysis results

Discount rate	DBO in kCHF	Change in DBO
-0.48%	70,817	21.3%
0.02%	64,077	9.8%
0.27%	61,106	4.7%
0.42%	59,438	1.8%
0.52%	***58,370***	***0.0%***
0.62%	57,335	-1.8%
0.77%	55,845	-4.3%
1.02%	53,514	-8.3%
1.52%	49,363	-15.4%

Source: Own work.

Table 22: Interest credit rate sensitivity analysis results

Interest credit rate	DBO in kCHF	Change in DBO
0.5%	56,708	-2.8%
1.0%	***58,370***	***0.0%***
1.5%	60,079	2.9%
2.0%	61,836	5.9%
2.5%	63,673	9.1%

Source: Own work.

Table 23: Salary increase rate sensitivity analysis results

Salary increase rate	DBO in kCHF	Change in DBO

table continues

Table 23: Salary increase rate sensitivity analysis results (cont.)

0.0%	56,175	-3.8%
0.5%	57,441	-1.6%
1.0%	***58,370***	***0.0%***
2.0%	60,125	3.0%
3.0%	61,920	6.1%

Source: Own work.

Table 24: Discount rate and conversion rate correlation sensitivity analysis results

Discount rate	Conversion rate	DBO in kCHF	Change in DBO
-0.48%	4.50%	66,870	14.6%
0.02%	5.00%	62,355	6.8%
0.27%	5.25%	60,301	3.3%
0.42%	5.40%	59,128	1.3%
0.52%	***5.50%***	***58,370***	***0.0%***
0.62%	5.60%	57,630	-1.3%
0.77%	5.75%	56,553	-3.1%
1.02%	6.00%	54,843	-6.0%
1.52%	6.50%	51,714	-11.4%

Source: Own work.

Table 25: Discount rate, conversion rate, and interest credit rate correlation sensitivity analysis results

Discount rate	Conversion rate	Interest credit rate	DBO in kCHF	Change in DBO
-0.48%	4.50%	0.00%	63,592	8.9%
0.02%	5.00%	0.50%	60,776	4.1%
0.27%	5.25%	0.75%	59,521	2.0%
0.42%	5.40%	0.90%	58,819	0.8%
0.52%	***5.50%***	***1.00%***	***58,370***	***0.0%***
0.62%	5.60%	1.10%	57,933	-0.7%
0.77%	5.75%	1.25%	57,302	-1.8%
1.02%	6.00%	1.50%	56,300	-3.5%
1.52%	6.50%	2.00%	54,493	-6.6%

Source: Own work.

Table 26: Conversion rate and capital option correlation sensitivity analysis results

Conversion rate	Capital option	DBO in kCHF	Change in DBO
4.00%	55.00%	49,927	-14.5%
4.50%	45.00%	52,453	-10.1%
5.00%	35.00%	55,267	-5.3%
5.50%	***25.00%***	***58,370***	***0.0%***
6.00%	15.00%	61,761	5.8%

Source: Own work.