IRM | institut du risk management BY Institut A

Mémoire présenté pour la validation de la Formation « Certificat d'Expertise Actuarielle » de l'Institut du Risk Management et l'admission à l'Institut des actuaires le 15/12/2021

Par : Sarah SENGDY

Titre : Analysis of the Accounting Volatility related to Interest Rates under IFRS 17 with the Building Block Approach

Confidentialité : ☒ NON ☐ OUI (Durée : ☐ 1an ☐ 2 ans)

Les signataires s'engagent à respecter la confidentialité indiquée ci-dessus

Membres présents du jury de l'Institut des actuaires :

Membres présents du jury de l'Institut du Risk Management :

Secrétariat :

Bibliothèque :

Entreprise : SCOR

Nom : Sarah SENGDY

Signature et Cachet :

Directeur de mémoire en entreprise :

Nom : Alexandre TZENEV

Signature :

Invité :

Nom :

Signature :

Autorisation de publication et de mise en ligne sur un site de diffusion de documents actuariels

(après expiration de l'éventuel délai de confidentialité)

Signature du responsable entreprise

Signature(s) du candidat(s)

Analysis of the Accounting Volatility related to Interest Rates under IFRS 17 with the Building Block Approach

Actuarial thesis
Sarah SENGDY

Acknowledgements

I would like to express my gratitude to my primary supervisor, Alexandre Tzenev, who has constantly supported me throughout the year, and my colleague, Baptiste Champavere for his technical support. I wish to acknowledge their constant availability to discuss the thesis, and their relevant comments to help me progress.

I wish to show my appreciation to Santiago Fiallos for sharing his expertise all along the progress of the thesis. His availability to discuss the topic has been key in the completion of the thesis.

More globally, I would like to thank the colleagues who have offered their deep insight into the study, and with who I have worked to finalize the thesis, such as the IFRS 17 team or the Long-Term Care reserving team. In particular, the assistance provided by Alexander Longmuir for proof-reading the thesis was greatly appreciated.

I would like to sincerely thank my life partner for not only proof-reading the paper, but also for his unconditional moral support. I would extend my special thanks to my friends and family for their constant support.

Résumé

Mots clés : IFRS 17, juste valeur, taux d'intérêt, volatilité comptable, gestion actif-passif, stratégie d'appariement des flux, stratégie d'appariement de la duration, duration effective

L'objectif des IFRS est de donner une présentation cohérente des rapports financiers pour tous les secteurs d'activité à travers le monde pour garantir la comparabilité des entreprises, la transparence des données rendues publiques et le reflet du risque réel. La particularité du business model de l'assurance et sa complexité expliquent pourquoi la norme pour les contrats d'assurance a mis du temps à être adoptée et pourquoi elle est mise en œuvre en deux phases. IFRS 4 (phase 1) a posé les bases et a limité les changements en autorisant l'utilisation des normes locales. Une des critiques faites à IFRS 4 est l'incohérence quant à la valorisation de l'actif et du passif. En effet, la plupart des régulations locales utilisent la méthode de valorisation historique pour les passifs techniques alors que l'actif est valorisé à la juste valeur. Cela créé de la volatilité comptable qui empêche d'évaluer le risque réel lié aux taux d'intérêt et de produire des estimations fiables. Cela peut se traduire par un coût du capital plus élevé sur les marchés financiers pour investir dans l'assurance. IFRS 17 (phase 2) doit aborder le problème de la juste valeur pour remplir les objectives des IFRS. Il abandonne la multitude des traitements comptables pour une approche unique et cohérente, et il se rapproche d'une comptabilité à la juste valeur. Il est donc prévu que IFRS 17 supprime la volatilité comptable. L'objectif du mémoire est d'analyser dans quelles mesures IFRS 17 supprime cette volatilité comptable entre l'actif et le passif technique. L'analyse porte sur la sensibilité aux changements de taux d'intérêt sous IFRS 17 à travers une étude de cas basée sur un portefeuille de dépendance.

Abstract

Key words: IFRS 17, fair value, interest rates, accounting volatility, asset and liability management, cash flow matching strategy, duration matching strategy, effective duration

The purpose of IFRS framework is to provide a coherent presentation of financial statements for all sectors across the world to ensure the comparability between companies, the transparency of the disclosure and the reflection of actual risks. The unique nature of the insurance business model and its complexity explain why the standard for insurance contracts came late compared to others and why it has been implemented in two steps. IFRS 4 (phase 1) set the foundation and limited material changes by allowing the use of local GAAP. One of the main critics attributable to IFRS 4 is the inconsistent valuation of assets and liabilities. Indeed, most local GAAP are assessing the technical liabilities at historical value, whereas the assets backing them are at fair value. It creates accounting volatility preventing the assessment of the effective risks related to interest rates, and the projection of reliable estimates. These can result in higher cost of capital for investing in an insurance company. IFRS 17 (phase 2) is expected to address the fair value aspect to fulfill the objectives of the IFRS. It moves away from the variety of treatments to a single consistent approach and moves towards a fair value accounting. Hence, it is expected that IFRS 17 would remove accounting volatility. The objective of the thesis is to analyze to what extent IFRS 17 removes accounting volatility between the technical liabilities and the assets backing them. The analysis focuses on the sensitivity to interest rates movements on the financial statements under IFRS 17 through a case study based on a long-term care portfolio.

Disclaimer

The thesis is based on the IFRS 17 Insurance Contracts issued in May 2017 and amended in June 2020, which is principal-based. The thesis is based on interpretations of the standard and discussions with actuary expects within and outside of SCOR. These interpretations may change after the implementation of the standard and with the interpretation of auditors.

The results provided in the thesis are based on simulations calibrated for a specific approach set for the purpose of the thesis only. In particular, the quantitative illustration is based on a long-term care portfolio from the French market. Any generalization or extrapolation of the results would require adjustments of the parameters.

Additionally, the dataset used in the thesis has been anonymized for confidentiality reasons. It reflects a certain demography at a certain time. Again, any extrapolation would require adjustments on the data.

Table of content

Introduction

The purpose of International Financial Reporting Standards (IFRS) framework is to provide a coherent presentation of financial statements for all types of sectors across the world. It is to ensure the comparability between companies, the transparency of the disclosure, and the reflection of actual risks (IASB, IFRS: who we are - our mission statement, n.d.). For that purpose, a series of accounting standards has been put in place to assess the different types of assets and liabilities, as well as to provide a framework for the presentation of financial statements. Overall, it aims to give a general and common framework for entities to account and present their business.

Insurance contracts are very specific contracts related to the unique nature of the insurance business model with the inverted production cycle, where the premiums are known and mostly received in advance of potential future claim payments. The premiums received are invested to match the expected future claims payments. In the meantime, insurers build sufficient technical provisions to ensure that they can meet the payout obligations toward their policyholders while taking into account the time value of money. This puts the concept of asset and liability management at the center of an insurer's considerations. In this same perspective, the International Accounting Standards Board (IASB) aims for a fair value accounting, which is defined as recording both assets and liabilities at the amount for which an asset could be exchanged, or a liability settled, between knowledgeable, willing parties in an arm's length transaction (IASB, IFRS 13 Fair Value Measurement - Appendix A, 2011)[1]. However, the absence of a liquid market for insurance liabilities unlike financial instruments is a challenge for the asset and liability management. Another complexity in the insurance space is that the insurance products differ from a country to another as well as their regulations, it results in various accounting treatments for insurance companies across countries.

Not only these specificities and the complexity around insurance contracts explain why the standard came relatively late compared to the other standards, but also why it has been decided to implement it in two phases. The first phase is known as IFRS 4 Insurance Contracts, which was introduced in 2004, to set the foundation of the insurance contracts standard. IFRS 4 was meant to be a temporary measure and to limit material changes for the insurers in their system. In particular, IFRS 4 permits a wide variety of treatments by allowing the use of local Generally Accepted Accounting Principles (GAAP) to account and assess insurance technical liabilities (IASB, IFRS 4 Insurance Contracts - Article 15, 2004).

One of the main critics attributable to IFRS 4 is the inconsistent valuation between the technical liabilities and the assets backing them in the balance sheet. Indeed, most of local GAAP are assessing technical liabilities at historical value, whereas the assets are at fair value, first with IAS 39 Financial Instruments, and now with IFRS 9 Financial Instruments. It creates accounting volatility in the financial statements, i.e., volatility only related to accounting rules, and not bearing economic information, such as volatility due to an economic turmoil or a pandemic for example. The volatility can be defined as a state of being likely to change rapidly and unpredictably, especially for the worse. Not only the accounting volatility prevents to assess the effective risk of an entity to interest rates movements as it does not bear any economic information. But it also represents a challenge for an entity to make reliable estimates for its own strategy. This has consequences on the potential risk premium that an analyst from the financial markets would add for investing in an insurance company. Therefore, having an understanding of the sensitivity to interest rates movements on financial statements under the new standard is key to better explain the volatility that may arise.

It was understood that the second phase would address the fair value aspect. Due to the complexity of insurance contracts, the implementation has been delayed several times. After many years of discussions, the second phase known today as IFRS 17 Insurance Contracts will finally replace IFRS 4 for annual accounting periods beginning on or after January 1, 2023. The new international accounting standard for insurance contracts was

[1] Appendix 1: Definitions from IFRS standards

issued in May 2017 and amended in June 2020. It will be implemented in approximatively (AICPA, n.d.). It is a major change in the treatment of insurance contracts, and it aims to harmonize their accounting globally, but also with other industries.

IFRS 17 is following the core objectives set by the IFRS: comparability, transparency, and reflecting actual risks. For that purpose, it first moves away from the variety of treatments to a single consistent approach to measuring profitability, allowing for direct comparison between entities reporting under IFRS accounting. Then, IFRS 17 moves towards a fair value accounting to have a consistent approach with the assets backing the technical liabilities and to achieve a fully fair valued balance sheet. Hence, with those two steps, it is expected that IFRS 17 would remove the accounting volatility, which was attributable to IFRS 4.

The objective of the thesis is to analyze to what extent IFRS 17 removes or at least reduces the accounting volatility between the valuation of assets at fair value and technical liabilities with the update of the discount curves. For that purpose, the analysis focuses on the sensitivity to interest rates movements on the financial statements under IFRS 17 through a case study based on a long-term care portfolio.

The long-term care business has been chosen for being (i) a non-regulated business compared to other life protection business, so it allows for a certain freedom or variety of treatments, and (ii) a long-term business, so the asset and liability management is even more relevant for long dated liabilities whilst the assets backing them have a shorter duration.

In terms of approach, the thesis addresses the matter in three chapters. The first chapter of the thesis introduces the framework and sets out the objective of the study. It provides details on the IFRS and the specificities of insurance contracts, and on the accounting of a long-term care portfolio under IFRS 4 and IFRS 17 with a focus on the sensitivity to interest rates movements.

The second chapter presents the model built for the thesis to address the objective set forth. It defines the assumptions taken, the yield curves and the asset and liability management strategies chosen, and the outputs used for the sensitivity analysis. It also details the computation of the impact of a change in interest rates on the technical liabilities and the assets backing them. The chapter finally describes the scenarios that are contemplated in the sensitivity analysis.

The third and final chapter analyzes the sensitivity to interest rates for the scenarios defined. It includes an analysis of the sensitivity to interest rates movements under IFRS 4 to better appreciate the change to IFRS 17. It then focuses on IFRS 17 under two asset and liability management strategies, a cash flow matching, and a duration matching, with two different interest rates movements, a parallel shift, and a non-parallel shift. Finally, the thesis discusses the implications of the sensitivity to interest rates movements for the insurance industry on the financial markets.

1. Framework and objective of the study

The first chapter aims to provide the framework and set out the objective of the thesis. The chapter first introduces the International Financial Reporting Standards (IFRS) to have an understanding of its nature and purpose, and an understanding of the specificities of insurance contracts. Those aspects of the IFRS are key for the thesis. It is followed by the presentation of the standard dedicated to insurance contracts. Due to the specificity and complexity of the insurance contracts, the standard is implemented in two steps, IFRS 4 and IFRS 17. The chapter presents the contribution of each of them before analyzing them through the accounting of a long-term care portfolio used as a case study. The thesis focuses on the concept of fair value of the technical liabilities under IFRS 17 and how it is expected to remove or reduce accounting volatility for an insurer.

1.1. The IFRS and the specificities of insurance contracts

1.1.1. Background of the IFRS

The body deciding the IFRS was the International Accounting Standards Committee (IASC) created in 1973 before becoming the International Accounting Standards Board (IASB) in 2001. It is an international private body with the purpose to develop a "single set of high-quality, understandable, enforceable and globally accepted accounting standards." (IASB, IFRS: who we are - about us, n.d.)

The IFRS are used in more than 120 countries as of 2020, among those, the countries from the European Union, several countries in Asia and South America. Specifically to the European Union, the European regulation (July 19, 2002) stipulated that the IFRS defined by the IASB are applicable to publicly accountable companies listed on the public stock exchange as well as financial institutions. These entities are legally required to publish their financial reports in accordance with agreed accounting standards. However, with the United States using their own Generally Accepted Accounting Principles (GAAP), as well as other countries across the world, the IFRS is therefore limited in terms of its universal applicability. (IFRS-Foundation, n.d.) [2]

The mission of the IFRS is to "develop IFRS Standards that bring transparency, accountability and efficiency to financial markets around the world.

- IFRS Standards bring transparency by enhancing the international comparability and quality of financial information, enabling investors and other market participants to make informed economic decisions.
- IFRS Standards strengthen accountability by reducing the information gap between the providers of capital and the people to whom they have entrusted their money. [The] Standards provide information needed to hold management to account. As a source of globally comparable information, IFRS Standards are also of vital importance to regulators around the world.
- IFRS Standards contribute to economic efficiency by helping investors to identify opportunities and risks across the world, thus improving capital allocation. Use of a single, trusted accounting language lowers the cost of capital and reduces international reporting costs for businesses." (IASB, IFRS: who we are - our mission statement, n.d.)

In other words, with the IFRS, an investor or any other market participants should be able to compare companies regardless of the sector or the country with accountable information that should reflect the actual risk of the companies. These objectives are key to understand and interpretate all standards issued by the IASB.

The IFRS have their importance in the global financial markets by maintaining transparency and trust. This helps investors to believe in the financial statements and other information shared by the companies, and also to compare one company to another regardless of their sectors. For industries where the public disclosures lack

[2] Appendix 2: Map of the countries using the IFRS Standards

transparency and accountability, it could lead to a higher cost of capital due to investors demanding higher risk premiums associated with an investment.

1.1.2. Specificities of insurance contracts

A series of standards has been put in place to assess the different types of assets and liabilities based on the service provided and to give a common framework for public disclosure. The following sections focus on the accounting of insurance contracts.

Insurance contracts are very specific contracts related to the unique nature of the insurance business model with the inverted production cycle, where the premiums are known and mostly received in advance of the potential future claim payments.

Due to this business model, the premiums received are invested to match expected future claims payments. In the meantime, insurers build sufficient technical provisions to ensure that they can meet the payout obligations toward their policyholders while including the time value of money. It requires a close asset and liability management, especially for technical provisions with long durations. For insurance accounting, the IASB aims for fair value accounting. Fair value can be defined as the recording of both assets and liabilities at the amount for which an asset could be exchanged, or a liability to be settled, between knowledgeable, willing parties in an arm's length transactions (IASB, IFRS 13 Fair Value Measurement - Appendix A, 2011)[3]. However, the absence of a liquid market for insurance liabilities unlike investments, but also constraints on financial instruments, such as the deepness of the market, represent a challenge for the asset and liability management.

Adding to this complexity, there are various accounting treatments of insurance companies across jurisdictions related to local specificities of insurance products and local market practices. It does not ease the comparability of the insurance industry across countries.

Because of those specificities and complexities related to insurance industry, the standard for insurance contracts has come relatively late compared to other standards, and it has been decided to implement the accounting for insurance contracts in two phases:

- Phase I is the current IFRS 4 Insurance contracts,
- Phase II is what is known today as IFRS 17 Insurance contracts.

The following two sections present the contribution of each phase for the implementation of the standard for insurance contracts.

1.1.3. IFRS 4 sets the foundation

IFRS 4 was introduced in 2004 and came into force on January 1, 2005. It has set the foundation and the floor for IFRS 17. IFRS 4 contributed to (i) set important principals and definitions, (ii) increase disclosure and (iii) limit accounting changes. (Murray, 2005)

(i) Setting important principals and definitions was key in the implementation of IFRS 4, such as the definition of an insurance contract (IASB, IFRS 4 Insurance Contracts - Appendix A, 2004)[4]. It was meant to ensure that similar transactions are treated in a similar way regardless of if it is written by a registered insurer or not. To standardize the treatment of insurance contracts across industries, the definition focuses on the economic transaction rather than on the legal form.

[3] Appendix 1: Definitions from IFRS standards
[4] Appendix 1: Definitions from IFRS standards

(ii) IFRS 4 required additional disclosure to improve the perception of the risk based on available information. This should serve the objectives of the IFRS: comparability, accountability and reflecting actual risks. The additional disclosures include qualitative and quantitative information, such as explanation of reported amounts, timing, and uncertainty of future cash flows (insurance risk, interest rates risk or credit risk). They are formulated based on principles rather than requirements. If this helps companies to comply with the standard's disclosure and are unlikely to become obsolete, it may reduce comparability between companies. The disclosure from insurance companies are particularly important as financial statements for insurance companies do not only gauge profitability, but they are also used to determine whether the insurance company can meet their payout obligations to the policyholders.

(iii) As it was planned to have the standard for insurance contracts implemented in two phases, IFRS 4 (phase 1) would permit companies to use their local GAAP (IASB, IFRS 4 Insurance Contracts - Article 25, 2004) limiting companies to change their accounting system twice, during the first and second phases. Nevertheless, IFRS 4 attempts to close the gap between fair value accounting and a historical value of local GAAP with:

- Removal of some reserves: The standard prohibits provisions for possible claims under contracts that are not in existence at the reporting date (such as equalization provisions). In other words, it removes the prudent margin in local GAAP technical provisions.
- Liability Adequacy Test (IASB, IFRS 4 Insurance Contracts - Article 15, 2004): The standard requires a test for the adequacy of recognized insurance liabilities and an impairment test for reinsurance assets. It ensures that insurance liabilities and reinsurance assets are not respectively underestimated and overestimated. At each reporting date, the insurer makes sure that the technical provisions are higher than the estimates of futures cash flows. In case of inadequacy, the delta is accounted in profits and losses (P&L) statement. (Thérond, 2009)
- Shadow Accounting (IASB, IFRS 4 Insurance Contracts - Article 30, 2004): It partially addresses the valuation mismatch between assets and liabilities. However, it introduces an artificial volatility, which makes difficult the reading, the understanding and the comparability of financial statements. Most insurers have chosen this approach under IFRS 4. The shadow accounting contributes to reduce the accounting mismatch between assets and liabilities: on the asset side, the accounting valuation is at fair value when the insurance liability is at historical value. An insurer is permitted, but not required, to change its accounting policies so that a recognized but unrealized gain or loss on an asset affects its insurance technical liabilities, related deferred acquisition costs and related intangible assets in the same way that a realized gain or loss does. The related adjustment shall be recognized in other comprehensive income. (Thérond, 2009)

Although IFRS 4 went in the right direction of the IFRS's missions to provide greater transparency and enhanced disclosures for insurance companies, it did not fully achieve the objective of comparability and reflecting actual risks:

- IFRS 4 permits a wide variety of treatments by allowing the use of local GAAP to account and assess the insurance technical liabilities for consolidated accounts. Going forward, the thesis refers to French GAAP when mentioning local GAAP.
- There are also distortions when using French GAAP for IFRS 4. Both frameworks have different purposes. French GAAP is in its nature prudent, while IFRS standards aim at providing a fair value to assess the profitability of a company.
- Finally, under IFRS 4, assets and liabilities are not both valued at fair value. It creates accounting volatility, which can be defined as volatility only related to accounting rules. It was understood that the fair value accounting would be fully addressed during phase 2 (IFRS 17).

1.1.4. IFRS 17 completes the standard for insurance contracts

IFRS 17 will replace the current IFRS 4 Insurance Contracts. The new international accounting standard for insurance contracts was issued in May 2017 and amended in June 2020. It will apply for annual accounting periods beginning on or after January 1, 2023.

IFRS 17 has set several objectives, among them are the improvement of comparability and of accounting volatility.

The comparability is expected to be achieved through:

- a single consistent approach across regions, moving away from local regulations and the prudential approach, and allowing to measure profitability consistently with the other IFRS standards. This should allow for direct comparison between entities reporting under IFRS across regions,
- an increasing granularity in terms of disclosure for more transparency and coherence with other industries' financial statements. In particular, the income statement of an insurer will drastically change, separating the insurance revenue from financial revenue, as well as the incurred profit from the accrued profit.

IFRS 17 aims to move towards a full fair value accounting, i.e., recording both assets and liabilities at the amount for which an asset could be exchanged, or a liability settled, between knowledgeable, willing parties in an arm's length transaction (IASB, IFRS 13 Fair Value Measurement - Appendix A, 2011). IFRS 17 will move away from the deferral and matching approach with a P&L focus to an asset-liability approach with a balance sheet focus. Assets and liabilities will be recognized to the extent that they meet the definitions set by the IFRS. The income and expenses are exclusively defined in terms of changes of assets and liabilities. An asset is defined as a resource expected to give future benefits and a liability is defined as an obligation arising from past events expected to result in an outflow of value from the company. For example, IFRS 4 Deferred Acquisition Costs (DAC) and Unearned Premium Reserves (UPR) are respectively an asset and a liability, but they do not meet the definition of an asset or of a liability. (Murray, 2005)

As mentioned in the section 1.1.2 Specificities of insurance contracts, asset and liability management represents a challenge for an insurer. Among the additional granularity requested by IFRS 17, the impact of interest rates on technical liabilities, either through the unwinding or the change in discount rates, will be desegregated from the technical cash flow movements. The increased granularity of disclosure and the fair value accounting of the technical liabilities should permit a better assessment of asset and liability management risk in theory. On the one hand, interest accretion (corresponding to the unwinding of the technical liabilities) will be accounted in the income statement, and the impact of a change in discount rates will be either accounted in the income statement, or in the other comprehensive income (OCI). On the other hand, with the insurance technical liabilities accounted at fair value, IFRS 17 aims at closing the gap of accounting volatility between assets and liabilities. In theory, in a closed environment where technical liabilities of a portfolio and their backing assets are cash flows and duration matched, and both are accounted at fair value, there would be no accounting volatility. The residual volatility will be the economic volatility that bears informational content of the economic environment.

In practice, the assessment of asset and liability management risk may not be as straightforward. The change in assets valuation is accounted through the asset revaluation reserve, and assuming that an insurer opts to account the impact of a change in interest rates on the technical liabilities through the OCI, the scope contemplated by the asset revaluation reserve and the OCI related to technical provisions is not the same:

- The asset revaluation reserve includes more than the volume of assets backing the technical liabilities. It also considers assets from the shareholders' equity or subordinated debts for example.
- Under IFRS 9, some financial instruments, such as equity or convertible bonds for example, have their revaluation impact going through the income statement, and not through the asset revaluation reserve.
- The asset revaluation reserve captures the market risk through risk-free rates movements but also the credit risk through the tightening or widening of credit spreads. Depending on the discount rates use

for the technical provisions, the update of the discount curve may not capture the credit default risk for example.

Therefore, looking at the balance sheet of an insurer as a whole, and not only at a closed block of business, the assessment of the asset and liability management risk tends to be a challenge.

Moreover, the comparability is somewhat limited as IFRS 17 remains a principal-based standard and provides little guidance about several key concepts for the valuation of technical provisions. For example, there is no methodology prescribed to:

- compute the risk adjustment for non-financial risk, which corresponds to one of the components of the technical liabilities,
- choose the coverage unit for the amortization of the Contractual Service Margin, another component of the technical liabilities, which determine the emergence of the technical profit,
- choose the yield curve to discount the technical liabilities.

It can lead to a variety of different possible approaches making the comparison between insurers difficult for an external stakeholder, but also internally for management to know where the company is positioned compared to its peers. Some mitigations are provided, such as the disclosure of those choices and the underlying methodologies and assumptions.

The first section shows that the IFRS tends to provide a comparable, transparent, and accountable framework for all industries. The standard for insurance contracts follows those objectives but not without difficulty due to the unique nature of the insurance business model. It makes the asset and liability management a key component to be assessed to ensure that an insurer can meet the payout obligations towards their policyholders while including the time value of money, in particular for long duration technical liabilities. The assessment of asset and liability management highlights the need for fair value accounting for both assets and liabilities that IFRS 17 aims to address for the technical liability side.

The following section deep dives into the accounting of technical liability under IFRS 4 and IFRS 17 of a long-term care portfolio used as a case study for the thesis. Given the importance of the fair value, the analysis has a focus on the sensitivity to a change in interest rates.

1.2. Accounting under IFRS 4 and IFRS 17 of a long-term care portfolio used as a case study

The long-term care business serves as a case study for the thesis. Given that the thesis focuses on the sensitivity to interest rates under IFRS 17, this business is interesting to look at because:

- It is not regulated compared to other life protection business, so it allows for a certain freedom or variety of treatments in terms of discount rates to be used and updated, or in terms of incidence tables.
- It is a long-dated business, so the asset and liability management is even more important with long dated liabilities whilst the assets have a shorter duration.

1.2.1. <u>Introduction of long-term care products in France</u>

Long-term care can be defined as the partial or total inability for an individual to perform activities of daily living without the assistance of another person. It can be a physical and/or cognitive impairment. It has to be differentiated from handicap, illness or disability, since long-term care is directly linked to a need for support from someone to compensate the lack of autonomy.

Long-term care is part of a societal issue in France. With an aging population, there has been an increase in the proportion of older demographics. Consequently, a higher proportion of the population is likely to need long-term care. According to INSEE’s estimates, 65+ population represented 20% of the population in 2018, and this proportion is likely to reach 30% by 2070. (Le Gal, 2020)

In order to objectively assess whether an individual requires long-term care and at which level of severity, there are two broad categories of definition:

- 'Actes de la Vie Quotidienne' (AVQ): Assess the capacity of an individual to complete daily life activities,
- Grid from 'Autonomie Gérontologie Groupes Iso-Ressources' (AGGIR): Assess the degree of lack of autonomy.

In France, there is a governmental organization providing support for individuals aged 60+ losing autonomy called 'Allocation Personnalisée d'Autonomie' (APA), which follows the AGGIR grid. Criticism has been raised towards the use of the grid, which is said to assess the degree of disability rather than the level of need of long-term care. However, there are limited alternatives currently.

The total cost of long-term care was at around 30 billion euros in 2014, of which 80% is funded by public authorities and 20% by individual households. The cost is expected to increase and reach around 35 billion euros by 2060. (Le Gal, 2020)

There are several types of long-term care insurance policies sold in France:

- Individual policies through different distribution channels such as banks, agencies, and mutuals
- Group policies included in Medical Expenses policies
- Group policies sold by 'institutions de prévoyance'[5] for private sector employees

For a long-term care insurance policy, a policyholder has three possible states:

- not on claims, i.e., alive and not in need of long-term care,
- on claims, i.e., alive and in need of long-term care,
- dead, either from being 'not on claims' or from being 'on claims'.

The main characteristics of the long-term care policies are:

- Underwriting age limit: between 70- and 75-year-old for individual policies, no limit for group policies
- Waiting period: usually three years for psychic deficiency and one year for the rest
- Deductible: usually three to six months, but not in all products
- Medical questionnaire: the details asked differ from one contract to another

The analysis of the above characteristic is to avoid the policy triggering in the first underwriting years. (Le Gal, 2020)

The long-term care risk is relatively new with the first product being sold in France in 1985. For a long-term risk, it usually requires more historical data and analysis. Although a lot of progress has been made in terms of biometric knowledge, it remains a risk hard to price. The main risks related to long-term care is the incidence trend, i.e., policyholders becoming on claims, and the longevity trend, i.e., policyholders remaining on claims. However, the long-term care product also bears long duration and therefore is highly sensitive to market risks, which will be addressed in the thesis.

Adding to the difficulty to price such a product, long-term care business is not regulated, so a variety of treatments exists. There are no regulated incidence or mortality tables to price for the biometric risks related to long-term care, nor any discount rates prescribed, unlike other life protection business.

[5] Institution de Prévoyance: Not-for-profit insurers that manage group life protection insurance for the risks of short and long-term disability, long-term care and death

1.2.2. Long-term care accounting under IFRS 4

Although the thesis addresses mainly IFRS 17, this section provides details on the accounting of the long-term care business under IFRS 4 to better understand the changes to IFRS 17 but also to serve as a comparison when analyzing IFRS 17.

As a reminder, IFRS 4 permits companies to use French GAAP to limit insurers to change their accounting system twice during the first and the second phases. The technical liabilities described in the section refer to French GAAP statutory accounting.

Due to the different possible status of a policyholder, the statutory accounting has two types of provisions for a long-term care policy:

- The provision for increased risks for not on claims policyholders
- The provision for incurred claims (or mathematical provisions) for on claims policyholders.

The provision for increased risk

The provision for increased risk is for not on claims policyholders. It ensures the long-term balance between constant premiums received over time and the increased risk of claims with the policyholder getting older. In the early years of a contract, the insurer receives premiums that are higher than the actual covered risk. The excess is building the provisions, which will be used when the risk will be higher than the premium received. (Luzon, 2019)

The present value of cash flows owed by the policyholders decreases with the payments of the premiums while the present value of cash flows owed by the insurer increases with the probability of the claims occurence.

- At inception, both present values are equal.
- Over the lifetime of the contract, those present values diverge, and the difference represents the provision for increased risk.

The provision for increased risk is computed based on:

- a mortality trend rate: the probability for a not on claims policyholder to die before being on claims,
- an incidence trend rate: the probability for a not on claims policyholder to become on claims,
- a discount rate.

The provision for incurred claims

The provision for incurred claims is for on claims policyholder. When a policyholder is in needs of long-term care, the insurer pays a capital or a monthly annuity until the death of the policyholder, and he or she stops paying premiums. In the case of monthly annuities, the insurer builds provisions for incurred claims, it is equal to the present value of the probable monthly annuities, knowingly that the policyholder is on claims of long-term care benefits. (Luzon, 2019)

The provision for incurred claims is computed based on:

- a longevity trend rate: the probability for a on claims policyholder remains on claims,
- a discount rate.

Long-term care: not a regulated business

Long-term care business is not regulated as per other life protection or savings business for example where mortality tables and discount rates are prescribed by the regulation.

- Each insurer is working with their own incidence and longevity rates tables under long-term care.
- Regarding the discount rates, they are defined within the treaty, and it is not required to update them. In practice, a single discount rate is used rather than a discount curve. It usually corresponds to the non-life discount rate prescribed by the French regulator equals to 75% of the average over 24 months of the "Taux moyen d'emprunt d'Etat" (TME). The non-life discount rate is preferred with regards to the nature of long-term care risks, which are closer to long-term disability than savings business for example. However, it is not a regulated business, therefore it is possible to see relatively high discount rate used for older business even in a low interest rates environment. Updating the discount rate is rarely seen on the market. If so, it will usually depend on the profit-sharing formula with policyholders and the level of return achievable on the asset side from the insurer.

Long-term care disclosure under IFRS 4

Although IFRS 4 has required additional disclosure, the impacts of interest rates (unwinding of the technical provisions and change in interest rates) are reflected in the technical result without the possibility to desegregate them from the technical profits (premiums, claims and expenses). It translates into a lack of transparency to analyze an insurer's revenue.

The IFRS 4 balance sheet below shows that technical provisions are not sensitive to interest rates movements on subsequent measurements of the portfolio and only the asset revaluation reserve captures those movements from the financial instruments. Therefore, the OCI is only impacted by the asset revaluation reserve changes for interest rates movements.

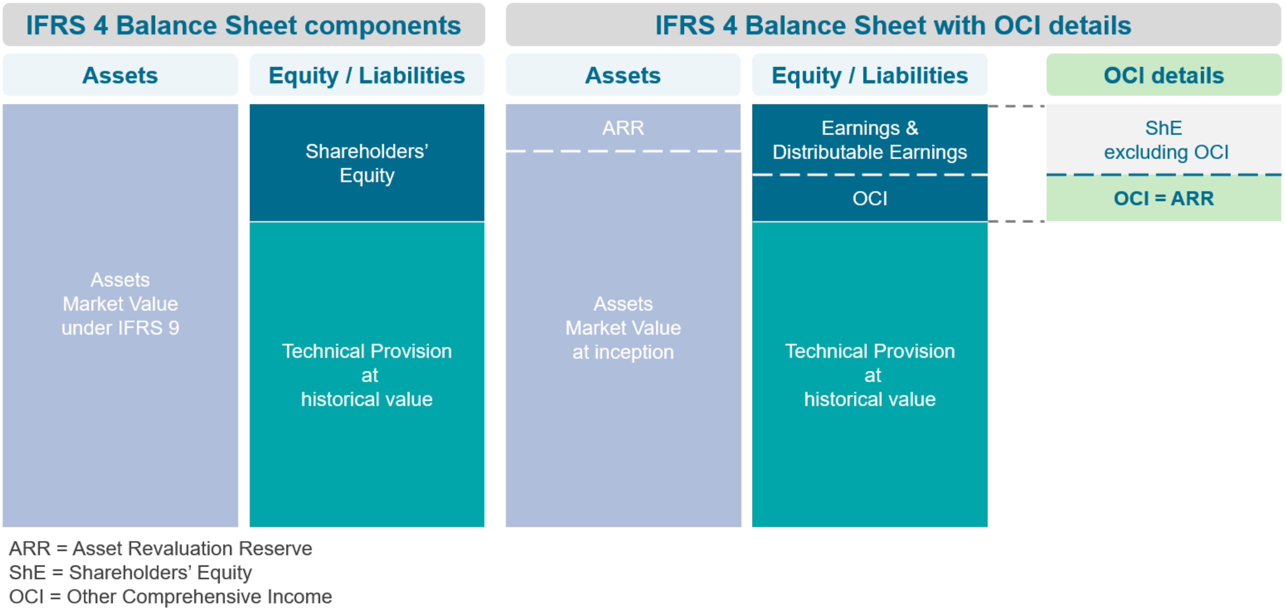


Figure 1: IFRS 4 Balance Sheet with OCI details

The IFRS 4 income statement below shows the main metrics that are used in financial analysis of an insurer: the Gross Written Premium and the Technical Result. The figure below also focuses on the unwinding of the technical liabilities and the impact of a change in discount rate on the technical result. The technical cash flows movements, the unwinding of the technical liabilities, and the impact of a change in discount rate are not desegrated from each other. Therefore, there is no possibility to assess the impact of the time value of money on the technical liabilities.

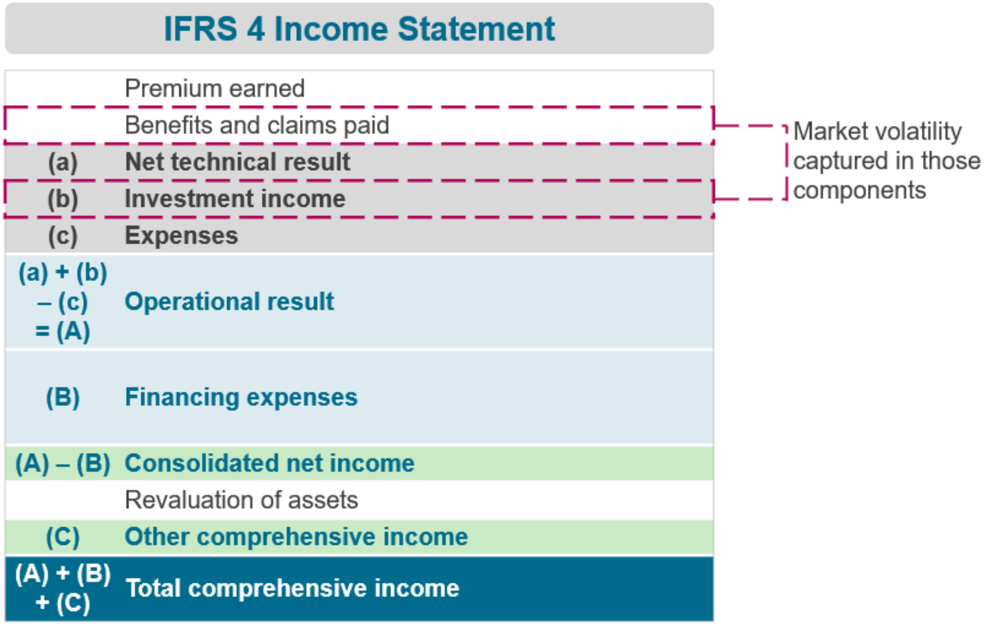


Figure 2: IFRS 4 Income Statement

1.2.3. <u>Long-term care accounting under IFRS 17</u>

The section aims at presenting IFRS 17 concepts that will be key to understand the sensitivity to interest rates on the income statement and the OCI under IFRS 17. Those concepts are also used in the model built, which is presented in the Chapter 2 of the thesis. Therefore, the section does not focus on the biometric assumptions and the impact of the change in biometric assumptions.

Perimeter: IFRS 17 approach

The underlying portfolio considered for the case study is a long-term care portfolio with no direct participation. Therefore, the thesis only considers the Building Block Approach (BBA). The Premium Allocation Approach (PAA) is left out as the thesis contemplates a long-term duration portfolio. The Variable Fee Approach (VFA) is as well excluded as the long-term care product has no direct participation features[6]. (IASB, IFRS 17 Insurance Contracts - Appendix A, 2020)

[6] Appendix 1: Definitions from IFRS standards

Technical liability components

Under the BAA, the technical liability is defined as the sum of three blocks:

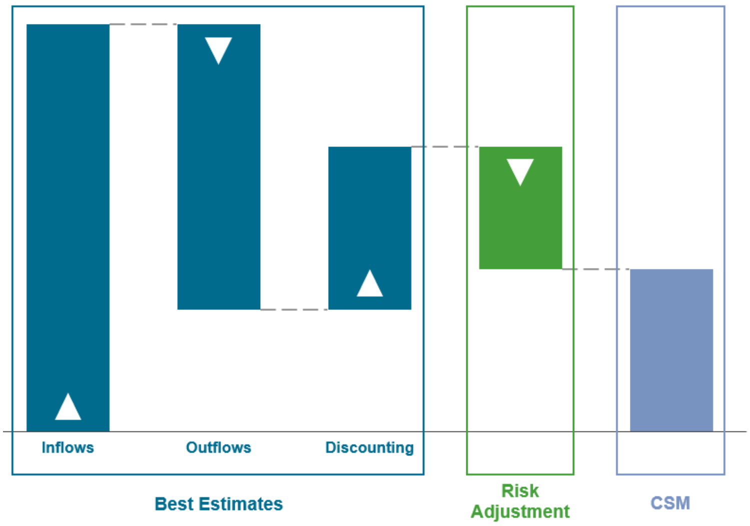
- The Best Estimates (BE) is the present value of the probability-weighted estimates of future technical cash flows,
- The Risk Adjustment for non-financial risk (Risk Adjustment) represents an adjustment to reflect the compensation for bearing the uncertainty about the amount and timing of technical cash flows that arises from non-financial risks,
- The Contractual Service Margin (CSM) represents the unearned profit that an insurer will recognize as it provides services in the future to its policyholders.

Technical liability valuation at inception

At inception, the three different components of the insurance liability under IFRS 17 are computed as follow:

- BE: The technical cash flows within the contract boundaries are projected (premiums, claims, expenses, directly attributable acquisition costs). The present value of those projected technical cash flows provides the BE.
- Risk Adjustment: There are no prescribed methodologies to determine the Risk Adjustment. A company could leverage on existing techniques such as cost of capital, confidence level or conditional tail expectation.
- CSM:
    - Should the sum of the BE and Risk Adjustment at inception be a net cash inflow, the CSM is equal to the opposite amount of that sum. Therefore, at inception, no income nor expenses arises.
    - Should the sum of the BE and Risk Adjustment at inception be a net cash outflow, the group of contracts is considered onerous. A loss is then recognized immediately in the income statement.

The flow chart below shows the BBA and the components for the valuation of the technical liabilities at inception. (KPMG, 2020) The BE is comprised of the technical inflows and outflows, and the time value of money.



Source: IFRS 17 First impressions (2020 update), KPMG

Figure 3: Building Approach at inception

Technical liability valuation on subsequent measurements

The insurance liability valuation on subsequent measurements is still the sum of the three components mentioned above but it differentiates between:

- Liability for Remaining Coverage (LRC) corresponding to the entity's obligation to pay for future insured events and insurance contracts services. In practice, it includes the BE and Risk Adjustment related to coverage that will be provided and the remaining CSM.
- Liability for Incurred Claims (LIC) corresponding to the entity's obligation to pay for insured events that have occurred, and insurance contract services already provided. In practice, it only includes the BE and Risk Adjustment for claims and expenses already incurred but not yet paid.

Specifically for long-term care business, the thesis assumes that under IFRS 17 the technical liabilities are not split between technical liabilities for not on claims and for on claims policyholders, unlike under IFRS 4. All projected technical cash flows are discounted and comprised in the LRC as they all relate to future insured events and insurance contracts services. The LIC only arises due to a timing difference between the claims being incurred but not yet paid. The thesis only considers the LRC and not the LIC, it assumes that the claims are incurred and paid at the same time, there is no lag in the payment. This treatment is not meant to be universal, other treatments can be seen on the market.

Discounting

The discounting aspect is particularly important under IFRS 17 being one of the main components for the move towards fair value accounting. (Jessop, 2019) The discounting of the technical liabilities at each reporting date shall:

- "reflect the time value of money, the characteristics of the cash flows and the liquidity characteristics of the insurance contracts;"
- "be consistent with observable current market prices (if any) for financial instruments with cash flows whose characteristics are consistent with those of the insurance contracts, in terms of, for example, timing, currency and liquidity; and"
- "exclude the effect of factors that influence such observable market prices but do not affect the future cash flows of the insurance contracts." (IASB, IFRS 17 Insurance Contracts - Article 17.36, 2020)

For cash flows that do not vary based on the returns of underlying items, they are discounted at a rate that:

- does not reflect such variability,
- reflects the return from currency-congruent financial instruments with negligeable credit default risk,
- considers the illiquidity of actuarial cash flows, where applicable.

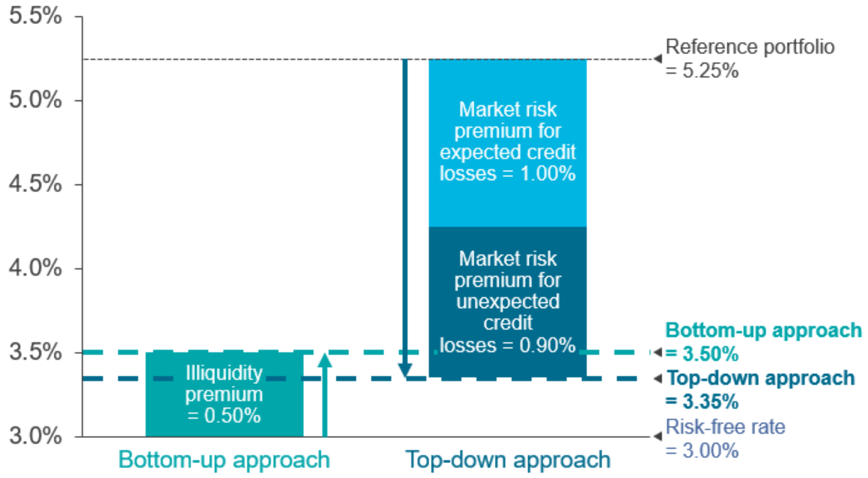
The definition of the discounting curve under IFRS 17 shows that it does not necessarily correspond to the expected return of the underlying assets backing the technical liabilities as the discount curve has to reflect the insurance contracts characteristics and liquidity, which may differ from investment instruments. This can create accounting volatility even with a cash flow and duration matching strategy between asset and liability.

Unlike Solvency 2, IFRS 17 does not prescribe discount curves nor estimation methodologies to derive discount rates. The standard only mentions that a 'top-down' or a 'bottom-up' approach can be used.

- Top-down approach: The base yield curve is calculated from the market value-based returns of a reference portfolio; the yield curve must be adjusted for the effect of the inherent credit default risk.
- Bottom-up approach: The base yield curve is calculated from the returns on financial instruments, which do not entail a significant credit default risk and are available for sale at any time without significant costs, the yield must be adjusted for the effect of different liquidity characteristics between the underlying financial instruments and the insurance contracts.

In principle, for cash flows that do not vary based on the performance of the underlying items, both approaches should result in the same discount curve if a single illiquid risk-free yield curve that eliminates all uncertainty about the amount and timing of cash flows exists. However, it differs in practice because of the inherent limitations in estimating the adjustments of illiquidity of insurance contracts and also the adjustments for different liquidity characteristics of a yield curve in the top-down approach.

The chart below shows an illustration of the top-down and the bottom-up approaches. (KPMG, 2020) It shows that the bottom-up and top-down approach are not resulting in the same discount curve.



Source: IFRS 17 First impressions (2020 update), KPMG
Figure 4: Bottom-up and Top-down approaches

The principals of the Fair Value Hierarchy in line with IFRS 13 must be applied when determining the discount yield curve on the basis of a reference portfolio (IASB, IFRS 17 Insurance Contracts - Article B82, 2020), i.e.

- observable market prices for financial instruments of the reference portfolio must be fully included (Level 1 of the Fair Value Hierarchy)
- if there is no active market for financial instruments of the reference portfolio, the market prices of comparable financial instruments (if necessary, with adjustments to ensure comparability) must be used (Level 2 of the Fair Value Hierarchy)
- if no market exists for financial instruments of the reference portfolio, estimation procedures must be used to determine the yield curve (Level 3 of the Fair Value Hierarchy)

The standard states that no specific techniques are prescribed when estimation procedures are applied, but instructions are provided on the type of information to be used for estimation (IASB, IFRS 17 Insurance Contracts - Article B78, 2020):

- Actual, observable and appropriate input factors are to be used as a priority, whereas the use of all non-observable data is to be minimized. (IASB, IFRS 17 Insurance Contracts - Article B44)
- Use of all available information – this includes both external and internal information and both market and non-market variables. The discount rate should not contradict any available market data, nor should variables used that are not observable on the market contradict the variables observable on the market.
- The discount rate should reflect current market conditions from the perspective of a market participant. If the company considered has special features (e.g., synergy effects), which other market participants do not have, the input factors must be adjusted for these effects.
- Differences in the properties in the insurance contract to the characteristics of the investments must be taken into account.

The duration is relatively long for long-term care portfolio, and the insurance obligation extends beyond the period for which observable market data is available. Therefore, estimation methodologies should be used for such portfolios.

When such a curve is defined at inception, this initial discount curve is called the ‘locked-in’ discount curve. It is used to:

- Measure the initial BE, Risk Adjustment and CSM,
- Measure the amortization of the CSM,
- Determine the interest to accrete the BE, Risk Adjustment and CSM,
- Determine the amount of the insurance finance income or expenses included in income statement if an insurer chooses to disaggregate insurance finance income or expenses between income statement, and OCI.

On subsequent measurements, the initial discount curve is updated, it is called the ‘current’ discount curve. It is used to:

- Measure the updated BE and Risk Adjustment,
- Determine the amount of the OCI related to the change between the ‘current’ curve and the ‘locked-in’ curve if an insurer chooses to disaggregate insurance finance income or expenses between income statement, and OCI.

Limitations appear in terms of comparability when IFRS 17 chooses not to prescribe discounting curves, unlike Solvency 2. It results in insurers having the possibility to apply different methodologies and therefore, it prevents direct comparison across entities and regions.

Presentation and disclosure

The presentation and disclosure under IFRS 17 are part of the main changes from the new standard. IFRS 17 aims at:

- Providing more details in the disclosure for additional insights and transparency,
- Aligning the presentation of revenue with other industries for greater comparability,
- Moving towards a balance sheet focus – unlike IFRS 4 – for more consistency by significantly expanding reconciliation of changes in each component of insurance contracts (assets and liabilities), including margins in the technical provisions.

<u>IFRS 17 Balance sheet</u>

Instead of having one block of technical provision, IFRS 17 will show the three blocks of BE, Risk Adjustment and CSM separately, the sum of which being the total technical liability.

The particularity of IFRS 17 is that at inception, the total technical liability will be equal to zero. As at inception, the CSM is set equal to the opposite sum of the BE and the Risk Adjustment. Then, on subsequent measurements, each block will be remeasured to reflect changes in biometric assumptions, but only the BE and Risk Adjustment are revaluated with the update of the discount curve.

IFRS 17 gives the option to account the impact of the change in interest rates either through income statement, or through OCI. Going forward, should the impact be accounted through OCI, it is then referred to as the OCI option. The choice depends on the assets’ allocation strategy chosen by the insurer. If the assets are accounted as fair value through OCI under IFRS 9, the OCI option would then better achieve an asset and liability matching. For European insurers, the average asset allocation is 61% in fixed income in 2020 (EIOPA, 2020). Those types of assets are accounted under the fair value through OCI under IFRS 9.

The table below shows the assets allocation of insurers from the European Economic Area for the year 2020. The total assets invested includes investments other than assets held for index-linked, unit-linked contracts, and holdings in related undertakings, including participations.

Year 2020	Assets Allocation	
	in EUR million	in %
Bonds	**4,894,712**	**61%**
Collective Investments Undertakings	1,597,773	20%
Loans & Property	655,088	8%
Equity	273,313	3%
Cash & Deposits	380,770	5%
Other investment	257,878	3%
Total assets invested	**8,059,534**	**100%**

Table 1: Average assets allocation for EEA insurers in 2020

In the balance sheet, the accumulated amount of the OCI is a component of the shareholders' equity and has to be disclosed separately from the equity and distributable earnings. The total OCI is computed as the difference between:

- Asset revaluation reserves corresponding to the difference between market value and initial valuation of the assets, and
- The OCI related to technical liabilities corresponding to the difference in technical liability valuation at current discount rates and locked-in discount rates, should the OCI option be chosen.

In the thesis, it is assumed that the financial instruments are accounted under IFRS 9. It is based on the concept that financial assets should be classified and measured at fair value, with changes in fair value recognized in P&L as they arise (FVPL), unless criteria are met for classifying and measuring the asset at either Amortized Cost (AC) or Fair Value through OCI (FVOCI)[7].

[7] Appendix 3: Decision tree for IFRS 9 financial assets classification

The IFRS 17 balance sheet below shows that the BE and Risk Adjustment are sensitive to interest rates movements, but not the CSM on subsequent measurements of the portfolio. Unlike IFRS 4, the OCI is impacted by both the change in asset revaluation reserve and by the impact of a change in interest rates from the technical liabilities.

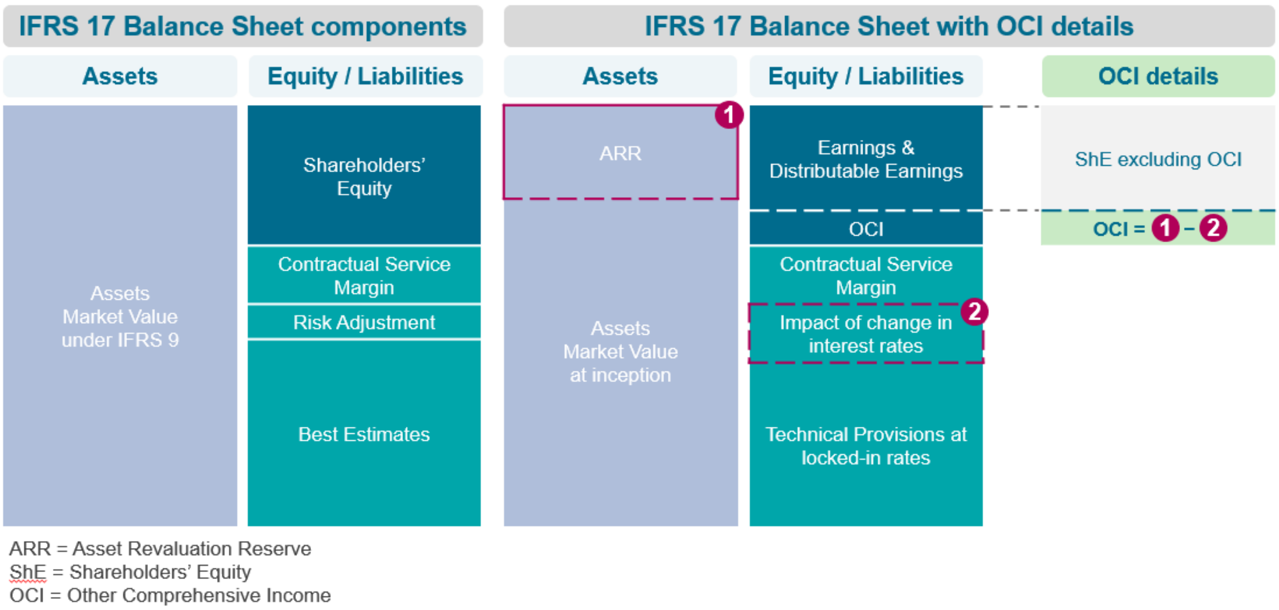


Figure 5: IFRS 17 Balance Sheet with OCI details

<u>Income statement</u>

IFRS 17 aims at aligning the presentation of revenue with the rest of the industries. For that reason, one of the main changes is the way of recognizing insurance result. Additionally, the income statement provides more granularity by splitting out the insurance income and expenses related to interest rates from the technical result. These changes have an impact on the financial communication of an insurer and its usual key performance indicators (KPI). Those are used by an entity to compare itself with its peers and by the financial markets to compare the insurance sector with other industries.

The expectation of IFRS 17 is to produce more stable earnings as services are provided. When on the balance sheet, the CSM is set equal to the expected future profits at inception, it is to reflect that no services are provided, and therefore, the profit recognized is zero. On subsequent measurements, the release of the CSM corresponds to services provided.

Under IFRS 17, the P&L disclosure attempts to differentiate between the source of profit or loss that arises from providing the insurance coverage and that arises from investment. The standard does not provide a precise income statement disclosure but does mention to split the insurance earnings into:

- Insurance revenue
- Insurance service expenses
- Insurance finance income or expenses

Insurance revenue and Insurance service expenses together form the Insurance service result.

The insurance revenue replaces the growth return premiums, it is calculated as the sum of:

- The expected inflows and outflows of the BE (premiums, claims and expenses),
- The release of the Risk Adjustment,

- The amortization of the CSM,

The insurance expenses include:
- The actual claims experience,
- The amortization of the directly attributable acquisition costs.

With those two components, an internal or external stakeholder will be able to assess the deviation between the actual cash flows from the expected cash flows. It is a way to assess either the technical margin being released through the income statement or the adverse claims experience against expected claims.

Changes in biometric assumptions have an effect that can be absorbed, up to the CSM. In the case where the CSM is depleted, subsequent changes in biometric assumptions result immediately in the income statement. This would lead to the establishment of a loss component to track the loss. (Morrison, 2018) In the thesis, the group of contracts considered is assumed profitable and there are no changes in biometric assumptions over the lifetime of the portfolio.

Insurance finance income or expenses and Investment return together form the net financial result.

The net financial result is comprised of insurance finance income or expenses and investment return from assets invested. Investment components do not provide services, and therefore are not included in the underwriting result and are presented separately in the income statement.

The insurance finance expenses only incorporate the impact of the unwinding of the technical liability discount rates, if the OCI option is chosen. It is called the interest accretion in the standard. If the impact of changes in discount rates on the fulfillment cash flows is not desegregated from the unwinding of the technical liabilities, the impact also flows through the insurance finance expenses. The interest accretion is applied on the BE, Risk Adjustment and CSM and is computed at locked-in rates.

The chart below shows where the impacts of interest rates on technical liability flow in the financial statements. The impacts of interest rates can be separated into two impacts: the impact of a change in interest rates and the unwinding of technical liability. The impact of a change in interest rates flows through the balance sheet in OCI, if the OCI option is chosen under IFRS 17, otherwise it flows through P&L. The unwinding of technical liability always flows through the P&L in Insurance Finance Expenses.

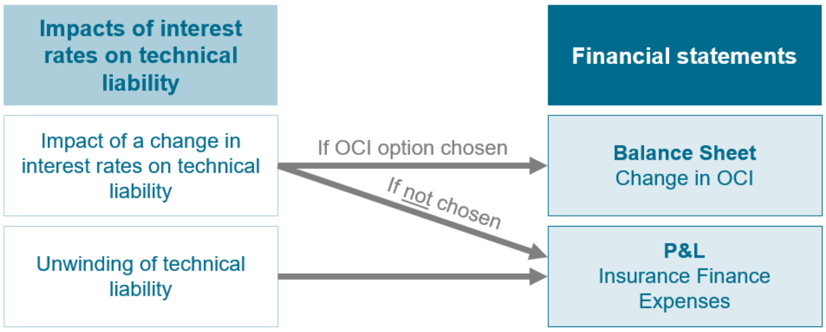


Figure 6: Impact of interest rates on technical liability on IFRS 17 financial statements

In the thesis, it is assumed that the financial instruments are accounted under IFRS 9. The investment return is then comprised of:
- Investment income representing the earning from the assets invested.
- Should the financial instrument be accounted at FVPL, the changes in fair value are recognized in P&L as they arise. As most assets are invested in fixed income in average for European insurers, it is

assumed for the thesis that all assets are invested in fixed income for simplification. The change in valuation for fixed income are accounted under FVOCI.

For a closed book of business and considering only the assets backing the technical liabilities, the insurance finance income and expenses, and the investment return arising from assets invested may be compared to assess the profitability of the asset portfolio. The difference of the two components can be seen as the actual performance of the asset portfolio with regards to the performance projected in the technical provisions at inception.

The IFRS 17 income statement below shows more granularity compared to IFRS 4. The unwinding of the technical liabilities and the impact of a change in interest rates are desegregated from the technical result. Therefore, IFRS 17 attempts to better assess the impact of the time value of money on the technical liabilities.

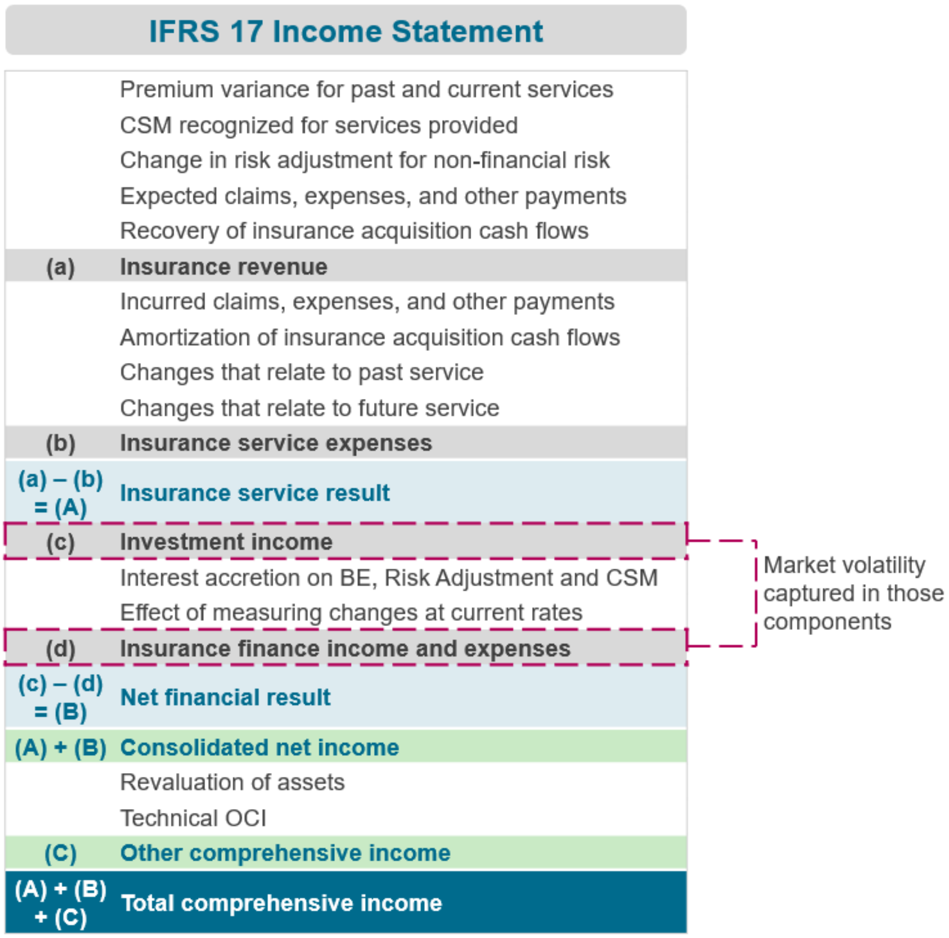


Figure 7: IFRS 17 Income Statement

The second section shows that one of the main changes from IFRS 4 is the move from a prudential approach of the technical liability valuation based on French GAAP to a fair value assessment by having the discount curve updated at each reporting date. However, the fair value is only partially applied to technical liability as it only affects the BE and Risk Adjustment, and not the CSM, while the assets would be fully accounted at fair value. Another significant change of IFRS 17 is the presentation and disclosure of the balance sheet and the income statement to be more aligned with the rest of the industries in terms of revenues presentation, where revenues are recorded as services are provided. IFRS 17 also adds more granularity in the disclosure, where the interest rates impact, either from the unwinding of the technical liabilities or the change in interest rates, are desegregated from the technical result, unlike IFRS 4.

1.3. Objective of the thesis

The first two sections have provided the framework to understand the topic addressed in the thesis. The following section aims to set forth the objective of the thesis.

1.3.1. The challenge of the accounting volatility

The previous sections show that IFRS 17 addresses the need of fair value accounting for the technical liabilities with the update of the discount curve at each reporting date to move away from the accounting mismatch of IFRS 4, where the assets are accounted at fair value while the technical liabilities are not. This type of accounting creates volatility on the OCI, where only the assets are subject to interest rates change. The current section explains why the accounting volatility is a challenge.

"Volatility can be defined as a state of being likely to change rapidly and unpredictably, especially for the worse" (dictionary). Therefore, in general, volatility is something that an entity would like to avoid or at least to understand as it represents a challenge for making reliable estimates. Volatility also translates negatively on financial markets as analysts and investors would usually apply an extra risk premium.

Volatility can have different sources. IFRS 4 shows that the technical provisions are not accounted at fair value, but the assets are. This is due to the fact that French GAAP does not require the update of the discount rate for the technical provisions. Therefore, the volatility that arises in the OCI is only related to the accounting rules defined in the French GAAP. Volatility can also bear economic information, for example during an economic crisis or a pandemic, the volatility is directly related to the economic environment. However, whatever the source of volatility, it is key to understand the interconnexion between the valuation of the technical liabilities and the valuation of the assets backing them.

Those valuations are sensitive to interest rates movements and impact the net income through the investment return and the unwinding of the technical provisions, and the shareholders' equity with the OCI through the impact of a change in interest rates. Those two components, net income and shareholders' equity, are some of the main KPI for a company, but they are also used to compute other KPI, such as the return on equity (ROE), the earnings per share (EPS) or the financial leverage ratio. Not only those KPI play a large role internally for an insurer to monitor its performance, to make strategic decisions, or to determine the shareholders' remuneration, they are also essential for external stakeholders, such as market analysts, investors, and other market participants, to compare the insurer with its peers but also to other companies from different industries and make informed economic decisions. In other words, volatility interferes with an insurer's strategy and objectives, and could increase an insurer's cost of capital when assessed by an external stakeholder.

Therefore, having an understanding of the sensitivity to interest rates on the net income and shareholders' equity under the new standard is key to better explain the volatility that may arise, and also to fulfill the objectives of comparability, transparency, and reflecting actual risks set by the IFRS.

1.3.2. The objective of the thesis relies on the objectives set by IFRS

The thesis relies on the core objectives of the IFRS, and on the fact that IFRS 17 pursues those objectives of:

- providing better comparability between companies, industries and across regions through a more consistent approach,
- providing improved accountability for external stakeholders through more transparency on the presentation and disclosure,
- reflecting actual risks of an insurer or reinsurer through fair value accounting and more granular disclosure.

Compared to other types of contracts across different industries, the insurance contracts with their specificities have their own standard, first with IFRS 4 as a first step and now with IFRS 17 as a second step. The insurance standard tends to achieve the same core objectives as the IFRS. IFRS 4 was mainly setting the foundation for IFRS 17 to fulfill the objectives. To have a better comparability, transparency, and reflection of actual risks, the fair value accounting of the technical liabilities is key in the assessment. IFRS 17 was understood to address the fair value accounting to remove the accounting volatility. It can be defined as the volatility, which is only related to accounting rules, such as the assets being accounted at fair value when the technical liabilities are not.

In theory, considering a closed block of insurance business with assets and liabilities being accounted at fair value, it is expected that the impact of interest rates would be neutral between the assets and the technical liabilities, should the chosen asset and liability management strategy be appropriate for the considered portfolio of business.

- Should the technical liabilities and the assets backing them are matching, and the technical liabilities be discounted by the expected return from the assets backing them, the impact on the income statement would be neutral. The unwinding of the technical liabilities would be offset by the investment return generated by those assets.
- Assuming that the OCI option is chosen, the impact of a change in interest rates from the technical liabilities would be offset by the change in asset revaluation reserve from the assets backing the technical provisions. However, the section 1.2.3 <u>Long-term care accounting under IFRS 17</u> shows that not all components of the technical liabilities are subject to the fair value accounting.
  In other words, IFRS 17 aims to remove or reduce the accounting volatility that was in IFRS 4, and any remaining volatility would be volatility bearing economic information.

The objective of the thesis is to analyze to what extent IFRS 17 removes or reduces the accounting volatility between the valuation of assets at fair value and technical liabilities with the update of the discount curves. For that purpose, the analysis focuses on the sensitivity to interest rates movements on the financial statements under IFRS 17 through a case study based on a long-term care portfolio.

1.3.3. Scope of the thesis to address the accounting volatility

The objective of the thesis set above is addressed through the case study of a long-term care portfolio. It has been chosen for its long liability duration, and therefore, its greater sensitivity to a change in interest rates. The thesis only focuses on the impact of interest rates and excludes impacts related to any changes in biometric assumptions.

IFRS 17 is assumed to be already in place, therefore the thesis is not addressing the transition period assessment. The considered portfolio is comprised of profitable group of contracts of one annual cohort, it is not expected to become onerous over the lifetime of the portfolio.

In order to better capture the impact of interest rates, the thesis also assumes that the insurer chooses the OCI option to account for the impact of the update of the discount rates, i.e., desegregated from the unwinding of technical provisions.

The analysis sets several scenarios to assess the accounting volatility under IFRS 17, starting with a theorical framework, where it is assumed that there is no change in interest rates over the entire projection period. The thesis is then contemplating two types of asset and liability management strategies, a cash flow matching strategy, and a duration matching strategy. The thesis considers two scenarios for the movements of the interest rates, a parallel shift, and a non-parallel shift. Both scenarios are contemplating additional constraints, such as the maturity limit to reflect financial markets constraints. The thesis does not aim at providing an exhaustive list of asset strategies, but it rather focuses on having an understanding of the impact of interest rates on insurance technical provisions under IFRS 17, and how it is interconnected with the assets backing them. The purpose of the analysis is to assess the mismatch on the OCI between the asset revaluation reserve and the OCI related to the technical provisions, and how this mismatch is sensitive to the constraints from financial markets.

The first chapter has set forth the objective of the thesis and has provided the necessary background to understand the model built to address the objective and the analysis of the results.
The model is presented in the Chapter 2 and is relying on the explanations of the accounting under IFRS 4 and IFRS 17 provided in the section 1.2 Accounting under IFRS 4 and IFRS 17 of a long-term care portfolio used as a case study. The Chapter 3 analyzes the results of the model and assesses the impact on the insurance industry and the financial markets.

2. Presentation of the model for the analysis of the sensitivity to interest rates

In order to fulfill the objective set for the thesis, a model is built to assess the mismatch on the OCI between the asset revaluation reserve and the OCI related to technical provisions. The Chapter 2 presents this model with the cash flows considered for the analysis, the computation of the technical provisions, and the valuation of the assets backing them. The chapter also presents the outputs from the model that are used for the sensitivity analysis in the Chapter 3. Finally, the chapter also describes the scenarios that are contemplated and analyzed in the Chapter 3.

2.1. Overview of the model

2.1.1. General presentation of the model

The model is built with Microsoft Excel and incorporates some macros using Visual Basis for Application (VBA) to ease some calculations needed from the model.

The model aims at assessing the sensitivity to interest rates on the OCI through the asset revaluation reserve and the OCI related to technical liabilities. The model analyzed the impact of this sensitivity on the financial statements, and more specifically on the net income and the ROE under IFRS 17. However, to better appreciate the change to IFRS 17, the model also assesses the sensitivity to interest rates on the OCI under IFRS 4.

The model is built in three different parts to assess:

(i) The sensitivity to interest rates on the technical liabilities: The model computes the technical provisions under IFRS 4 and IFRS 17.
  - For IFRS 4, the model computes the provisions for increased risk and the provisions for incurred claims for each runoff year and they do not change when looking at different reporting year as it is assumed that there is no change in the discount rate used over the runoff period.
  - For IFRS 17, the model provides all three components of the technical provisions – BE, Risk Adjustment and CSM – for each runoff year but also for each reporting year, as the discount curve changes over time.
  - For both standards, the model splits out the impact of interest rates, namely the unwinding of the technical liabilities and the impact of a change in interest rates, even though this granularity is not required under IFRS 4.
  - Also, for both standards, the model computes the effective duration of the technical liabilities for each runoff year and each reporting year in the perspective to use the duration matching strategy.

(ii) The sensitivity to interest rates on the assets backing the technical liabilities: The model computes the valuation of the assets backing the technical liabilities under two approaches.
  - Cash flow matching strategy: The model considers zero-coupon bonds and provides the valuation and the investment return for each runoff year and reporting year. The redemption of zero-coupon bonds would match the technical cash outflows.
  - Duration matching strategy: The model also considers zero-coupon bonds for this approach and provides the valuation and the investment return for each runoff year and reporting year. The duration of the asset portfolio is computed for this approach and compared to the duration of the technical liabilities.

(iii) The assessment of the accounting volatility between assets and liabilities: The sensitivity to interest rates on the technical liabilities and the assets backing them is summarized in financial statements and financial metrics.
  - Financial statements: As both assets and liabilities are analyzed together and not separately, the technical provisions and the assets are put together in a cash flow statement, a balance sheet, and an income statement. There is a focus on the components that are sensitive to interest rates, such as the OCI and the net financial result. The financial statements are presented in detail in the section 2.4.1 Outputs: Financial statement.
  - Financial metrics: To better fulfill the objective of the thesis, the model provides specific financial metrics that are analyzed in the Chapter 3. Those metrics are presented in the section 2.4.2 Outputs: Financial metrics. It includes:
    - the impact of changes in interest rates on the technical provisions,
    - the duration mismatch between the technical liabilities and the assets backing them,
    - the mismatch of the net financial result between the unwinding of the technical liabilities and the investment return,
    - the change in OCI,
    - the ratio between the change in OCI and the net income weighted with the sum assured, and
    - the deviation of the ROE.

The model proposes an appraisal of IFRS 4, then a focus on IFRS 17 through two asset and liability management strategies, a cash flow matching strategy and a duration matching strategy.

2.1.2. Presentation of the long-term care portfolio considered

As mentioned in the previous chapter, a long-term care portfolio is considered for the study, mainly for its long technical liabilities duration being more sensitive to interest rates.

The long-term care product considered for the thesis has the following characteristics:
- It has been launched in the 2010's,
- It offers total and partial long-term care benefits,
- It pays benefits in the form of monthly annuities, and provides optionality to receive a lump-sum payment,
- It includes the following features: deductibles, medical selection, and a waiting period.

The portfolio counts around 1,500 policyholders at inception with an average age of 58-year-old and a gender split of 60% and 40% between women and men, respectively.

The cash flows have been projected based on SCOR's own estimates in terms of incidence rates and mortality rates for both on claims and not on claims policyholders. The cash flows have been anonymized to respect the confidentiality of the data. The projected cash flows run off in 69 years. To simplify the model, the expenses have been excluded and it has been assumed that the premiums and claims are both received and paid at the same time and at the end of each reporting year.

The model differentiates between the runoff year and the reporting year.
- The runoff year t corresponds to the cash flows or the present value of the cash flows of the year t.
- The reporting year i bears the economic assumptions of the year i.
- In other words, the technical liabilities, i.e., the present value of the technical cash flows, of the year t can be assessed with the economic assumptions of the year i for example.

The chart below shows the runoff of the technical cash flows and the sum assured of the considered portfolio. The technical cash flows include the premiums, the claims, the amortization of the Risk Adjustment, and the CSM. For the first 12 years, the net cash flows are inflows when the insurer is mainly collecting premiums and not paying claims, and from the year 13 on, the net cash flows are outflows when the policyholders are getting older, and claims are being paid.

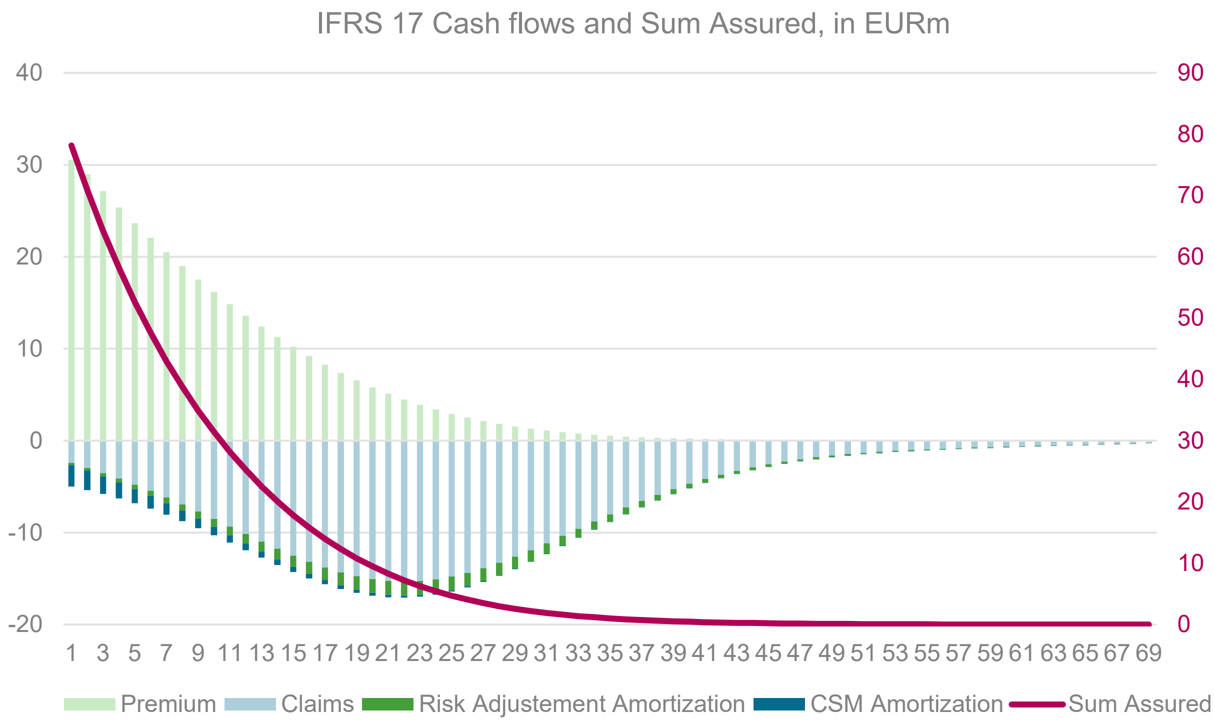


Figure 8: IFRS 17 Cash flows and Sum Assured

The following notations are used to describe the cash flows:

$Premium_{i_x}$	corresponds to the premium for the policyholder i aged x.
$Claim(t)$	corresponds to the claims for the runoff year t.
$NTCF(t)$	corresponds to the net technical cash flow for the runoff year t.
$SA(t)$	corresponds to the sum assured for the runoff year t.
N	corresponds to the total number of runoff years.

The three following sections present the three parts of the model in details, and the final section describes in detail the considered scenarios.

2.2. Interest rates sensitivity on technical liabilities

The section focuses on the computation of technical provisions under IFRS 4 and IFRS 17 with a focus on the interest rates sensitivity. As mentioned in section 1.3.3 Scope of the thesis to address the accounting volatility, the underlying technical cash flows considered (premiums, benefits for on claims and not on claims policyholders) do not change over the runoff period, i.e., the biometric assumptions are fixed at inception.

2.2.1. IFRS 4: Long-term care technical liabilities

As IFRS 4 allows the use of French GAAP, the model for IFRS 4 is following the treatment under French GAAP.

The particularity of the long-term care business is that it is not a regulated business under French GAAP, resulting in a certain flexibility in setting the discount curve for example. In practice, a flat curve is used, and the discount rate is usually the non-life rate provided by the French regulation. It corresponds to 75% of the average TME over the past 24 months. The TME is at 0.23% as of 31/10/2021 and the average over the past 24 months is at -0.04% (SPAC, n.d.). Therefore, the non-life regulated discount rate stands at -0.03% (SPAC, n.d.). However, it is not unusual to have higher discount rate that has not been updated, it depends on the level of return achievable on the assets side.
For confidentiality reason, the discount rate for the contemplated long-term care portfolio is modified and is set at 1.50% for the model. For the computation of the technical liabilities, the discount rate is not updated for the entire projected period. Therefore, there is no impact from a change in interest rates.

The technical liabilities for not on claims policyholders (provisions for increased risk) and on claims policyholders (provisions for incurred claims) are computed separately. IFRS 4 does not require to desegregate the unwinding of the technical provisions. These are all aggregate under the technical result. However, the model does desegregate those impacts for the analysis purpose when comparing with IFRS 17.

The following notations are used to describe IFRS 4 technical provisions:

${}_kp_x^v$	corresponds to the probability of an individual alive and not on claims to stay alive between age x and $x+k$, knowingly that he/she is alive and not on claims at the age x.
${}_kp_x^d$	corresponds to the probability of an individual alive and on claims to stay alive between age x and $x+k$, knowingly that he/she is alive and on claims at the age x.
i_x^d	corresponds to the probability of an individual aged x to become on claims.
l_x^v	corresponds to the number of individual alive and not on claims.
l_x^d	corresponds to the number of individual alive and on claims.
w	corresponds to the maximum age on mortality tables.
r_ifrs4	corresponds to the discount rate used for IFRS 4.
$v = \frac{1}{(1+r_{ifrs4})}$	corresponds to the discount factor under IFRS 4.

The technical provision for increased risk for the runoff year t for a policyholder i aged x when the policyholder subscribed the contract is equal to:

$$\boldsymbol{PRC_{i_x}(t) = Amount_{due_{i_x}}^{Insurer}(t) - Amount_{due_{i_x}}^{Policyholder}(t),} \qquad (1)$$

$Amount_{due_{i_x}}^{Policyholder}(t)$	corresponds to the present value of the probable amount owed by the policyholder i aged x when the policyholder subscribed the contract and aged $x+t$ at valuation date.
$Amount_{due_{i_x}}^{Insurer}(t)$	corresponds to the present value of the probable amount owed by the insurer to the policyholder i aged x when the policyholder subscribed the contract and aged $x+t$ at valuation date.

The amount owed by the policyholder to the insurer is equal to the payment of the premium while the policyholder is still alive and not on claims. The present value of the probable amount owed by the policyholder is the sum of the future premiums to be paid to the insurer with the probability that the policyholder remains alive and not on claims discounted at the discount rate.

$$\ddot{a}_{x+t}^{v} = \sum_{k=0}^{w-(x+t)} \frac{l_{x+t+k}^{v}}{l_{x+t}^{v}} \times v^k = \sum_{k=0}^{w-(x+t)} {}_kp_{x+t}^{v} \times v^k ,$$

$$Amount_{due_{i_x}}^{Policyholder}(t) = Premium_{\,i_x} \times \ddot{a}_{x+t}^{v} .$$

The amount owed by the insurer to the policyholder is equal to the settlement of the annuities when the policyholder becomes on claims. The present value of the probable amount owed by the insurer is the sum of the future annuities to be settled for the policyholder with the probability that the policyholder does not die and becomes on claims discounted at the discount rate. The formula below is given for a €1 annuity.

$$a_{x+t+k}^{d} = \sum_{j=1}^{w-(x+t+k)} \frac{l_{x+t+k+j}^{d}}{l_{x+t+k}^{d}} \times v^j,$$

$$Amount_{due_{i_x}}^{Insurer}(t) = \sum_{k=0}^{w-(x+t)} {}_kp_{x+t}^{v} \times i_{x+t+k}^{d} \times v^k \times a_{x+t+k}^{d} .$$

The technical provision for incurred claims for a policyholder i aged x when the policyholder subscribed the contract and aged $x+t$ at valuation date is equal to the present value of the sum of future annuities to be settled for the policyholder with the probability that the policyholder does not die knowingly that the policyholder is on claims discounted with the discount rate. It is assumed that being on claims is a permanent state. The formula below is given for a €1 annuity.

$$a_{x+t}^{d} = \sum_{k=1}^{w-(x+t)} {}_kp_{x+t}^{d} \times v^k ,$$

$$\boldsymbol{PM_{i_x}(t) = a_{x+t}^{d}.} \qquad (2)$$

2.2.2. IFRS 17: Long-term care technical liabilities

The following section provides the computation of the three components of the technical liabilities – the BE, the Risk Adjustment and the CSM – and their fair value at each reporting date under IFRS 17. With the update of the discount rate for the technical liabilities, the model extracts the impact of interest rates: the interest accretion and the impact of the change in interest rates for each runoff year and each reporting year. The section also provides details on the discount curves used and how they are derived for the projection years according to a parallel shift and a non-parallel shift. Finally, in anticipation of the duration matching strategy applied to the assets backing the technical liabilities, the section provides a detailed explanation of the computation of the duration of the technical liabilities.

Technical liabilities components

The model projects IFRS 17 technical liabilities components (BE, Risk Adjustment and CSM) at locked-in rates and at current rates for each runoff year. In other words, the model computes the technical liabilities for all runoff years at each reporting year's economic assumptions. For example, the model computes the projected technical liabilities from the year 1 to the year 69 with the economic assumptions of the year 1, then it computes the projected technical liabilities from the year 2 to the year 69 with the economic assumptions of the year 2, and so on.

The following notations describe the discount rates:

$r_i(t)$ corresponds to the spot technical liability discount rate for the reporting year i of the runoff year t,

$r_i^{fwd}(t)$ corresponds to the 1-year forward technical liability discount rate for the reporting year i of the runoff year t,

It is assumed that

$$\text{for } t = 0,$$
$$r_i(0) = r_i^{fwd}(0) = 0.$$

The relation between spot rate and forward rate is given by the following formula:

$$r_i^{fwd}(t) = \begin{cases} r_i(t), & t = 1 \\ \dfrac{(1 + r_i(t)\,)^t}{(1 + r_i(t-1)\,)^{t-1}} - 1, & t > 1 \end{cases}. \quad (3)$$

The BE for the reporting year i of the runoff year t is equal to the present value of the sum of the net technical cash flows:

$$BE_i(t) = -\sum_{j=t+1}^{N} \frac{NTCF(j) \times (1 + r_i(t))^t}{(1 + r_i(j))^j}. \quad (4)$$

As a reminder, there is no prescribed methodologies to determine the Risk Adjustment. A company could leverage on existing techniques such as cost of capital, confidence level or conditional tail expectation. The focus of the thesis is not on the Risk Adjustment calculation. Therefore, the model assumes a simplified approach where the Risk Adjustment represents 10% of the claims amount. The Risk Adjustment for the reporting year i of the runoff year t is equal to the present value of the sum of 10% of the claims:

$$RA_i(t) = -\sum_{j=t+1}^{N} \frac{10\% \times Claim(j) \times (1+r_i(t))^t}{(1+r_i(j))^j} \,. \tag{5}$$

The CSM for the runoff year t is equal:

$$CSM(t) = \begin{cases} -(BE_0(0) + RA_0(0)), & t = 0 \\ CSM(t-1) \times (1 - A(t) + r_0^{fwd}(t)), & t > 0 \end{cases}, \tag{6}$$

$$\text{where } A(t) = \frac{\frac{SA(t)*(1+r_0(t-1))^{t-1}}{(1+r_0(t))^t}}{\sum_{j=t}^{N} \frac{SA(j)*(1+r_0(t-1))^{t-1}}{(1+r_0(j))^j}} \,.$$

The IFRS 17 technical provision is equal to the sum of the three components:

$$\boldsymbol{TP_i(t) = BE_i(t) + RA_i(t) + CSM(t)} \,. \tag{7}$$

Discount rates

For a recollection of the principals and guidelines for the discount rates under IFRS 17, please refer to the section 1.2.3 Long-term care accounting under IFRS 17.

The derivation of an appropriate interest rate discount curve for IFRS 17 is not the purpose of the thesis. For simplicity, the EIOPA curve with Volatility Adjustment is used in the model for discounting IFRS 17 technical provisions. The appropriateness and the limitations of this curve are discussed in the following paragraphs.

EIOPA discount curve as the risk-free curve basis:

- EIOPA discount curve is based on Swap rates, which are usually liquid but bear a counterparty risk of short-term credit default risk. However, the EIOPA curve bears a correction with the Credit Risk Adjustment, which is not market-based but rather formula-based. Therefore, using a formula-based approach may contradict the IFRS requirement to make best use of market data.
- The concept of Last Liquid Point defined by Solvency 2 can be appropriate for IFRS 17 to the extent that Solvency 2 uses the maximal duration where reliable market information is available. It would fulfil the Level 1 principal of IFRS 13 to fully include observable market prices. However, the choice of the Last Liquid Point may be different between Solvency 2 and IFRS 17. IFRS requires the existence of quote and transactions on an active market but not necessary a sufficient deepness and liquidity, that Solvency 2 requires. For example, the maximal duration of the EUR Swap curve is 50 years, when the Last Liquid Point of Solvency 2 remains at 20 years. Therefore, the Last Liquid Point for IFRS 17 may be longer than 20 years.
- Beyond that point, Solvency 2 proposes an extrapolation method based on an Ultimate Forward Rate. It is supposed to reflect the economically expected value of the interest rate in a non-observable future far beyond the Last Liquid Point. It is based on long-term inflation expectation and an expectation of the real interest rate.

The discount rates of IFRS 17 requires reflecting the illiquidity adjustment equals to the differences in the liquidity characteristics between the insurance contract liabilities and the underlying investments instruments. A reference assets portfolio should then be selected for this assessment.

- EIOPA reference portfolio of assets for calculating the Volatility Adjustment relies on average data across European insurers.
- While the Solvency 2 Volatility Adjustor is meant to adjust technical provision for regulatory purpose by reflecting some excess return that can be earned on a bond portfolio, the Illiquidity Adjustment from IFRS 17 conceptually reflects the additional spread that could be earned under a fully illiquid investment, dependent on the duration of the reference portfolio. Thus, the motivation of the adjustments is different between Solvency 2 and IFRS 17.

The locked-in discount curve chosen is the EIOPA discount curve with Volatility Adjustment as of 31/12/2015. The year 2015 has been preferred to start with an environment where the interest rates were not as low as in 2019 or 2020. The low and negative interest rates environment is illustrated through the negative shift applied during the runoff period.

$r_0(t)$ = EIOPA discount curve with Volatility Adjustment 31/12/2015 for the runoff year t,

The chart below shows the EIOPA discount curve with Volatility Adjustment as of 31/12/2015. The curve starts relatively low at 0.06% and goes up to 3.79%.

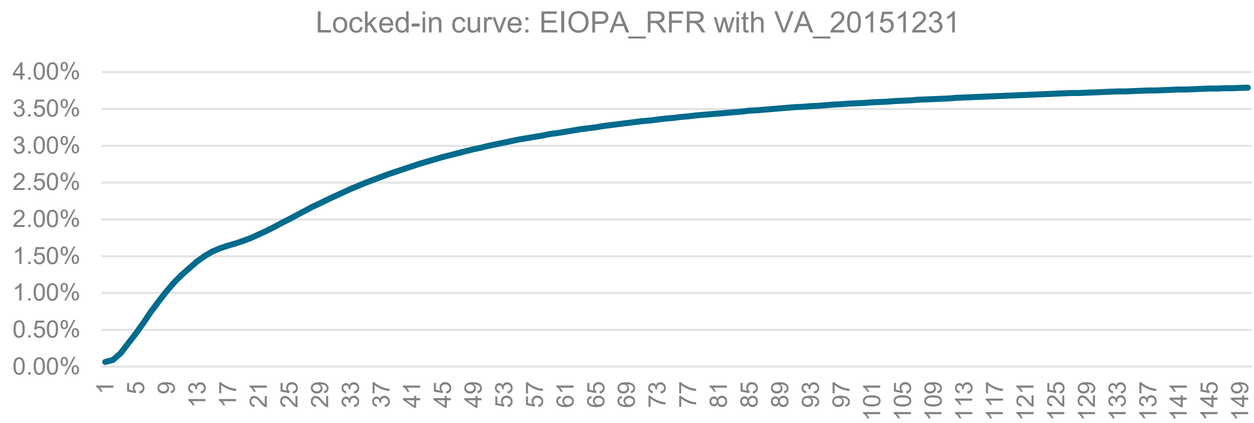


Figure 9: Locked-in curve: EIOPA_RFR with VA_20151231

For the update of the discount curve at each reporting date, the model assumes two approaches: a parallel shift and a non-parallel shift.

Parallel shift: It corresponds to when all yield points move in the same direction and by the same amount. A shock of -10 basis points (bps) is applied every year on the reference discount curve.

$$r_i(t) = r_0(t) - 10 \text{ bps} \times i, \quad (8)$$

The chart below shows the locked-in discount curve and the current discount curve for the runoff year 1 with a parallel shift. For all maturities, the yield point is lowered by 10 bps.

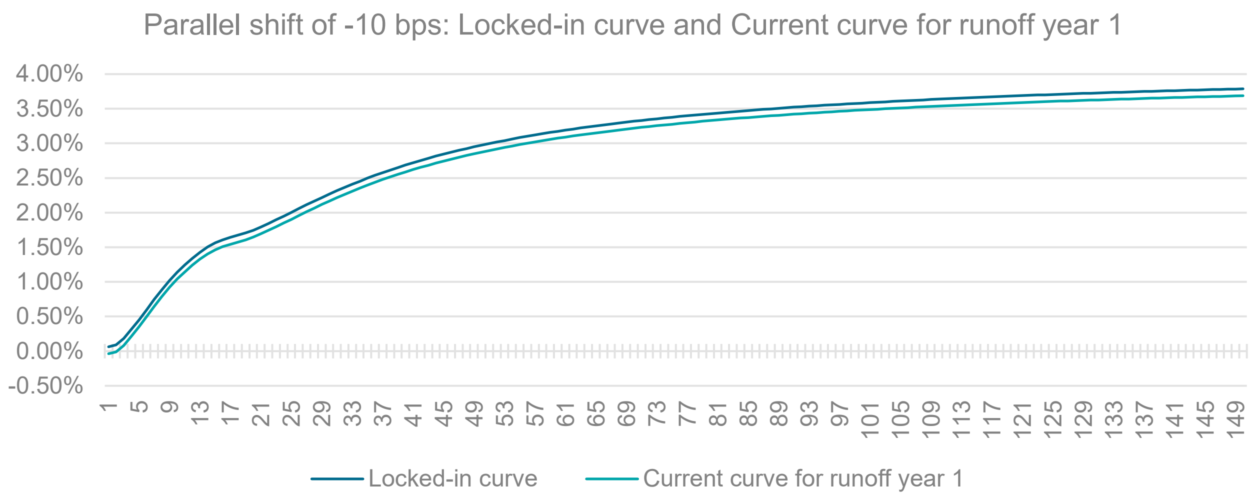


Figure 10: Parallel shift of -10 bps: Locked-in curve and Current curve for runoff year 1

Non-parallel shifted: It corresponds to when several yield point changes are of different signs and/or different orders of magnitude. The model achieves the non-parallel shift in several steps, as described below:

- The locked-in discount curve is shifted by one year.

$$r_1(t) = r_0(t-1),\ t > 0\ .$$

- The difference $r_1(t) - r_0(t)$ represents the shift from the locked-in curve to the current curve of the runoff year t for the reporting year 1. It is noted:

$$R_1(t) = r_1(t)\ - r_0(t),\ t > 0\ .$$

- The non-parallel shifted curve is built to achieve an equivalent of -10 bps parallel shift using the partial duration methodology (Reintano, 1991)[8]. For that purpose, a spread s is applied to $R_1(t)$ so that the sum of all partial durations multiplied by $R_1(j) + s$ is equal to 10 bps. The spread s is defined by the following equation:

$$\sum_j \frac{\frac{j}{(1+r_0(t))^{j+1}}}{\sum_i \frac{1}{(1+r_0(t))^i}} \times (R_1(j) + s) = 0.001\ .$$

- The model solves the spread s:

$$s = -0.06715\%\ ,$$

[8] Appendix 5: Nonparallel Yield Curve Shifts and Duration Leverage

and the current curves are computed as follow:

$$\text{for } i > 0 \ t > 0,$$

$$r_i(t) = r_0(t+i) + \sum_{j=t}^{t+i-1} R_1(j) + s \ . \qquad (9)$$

The chart below shows the locked-in discount curve and the current discount curve for the runoff year 1 with a non-parallel shift. All yield points are not changes by the same order of magnitude.

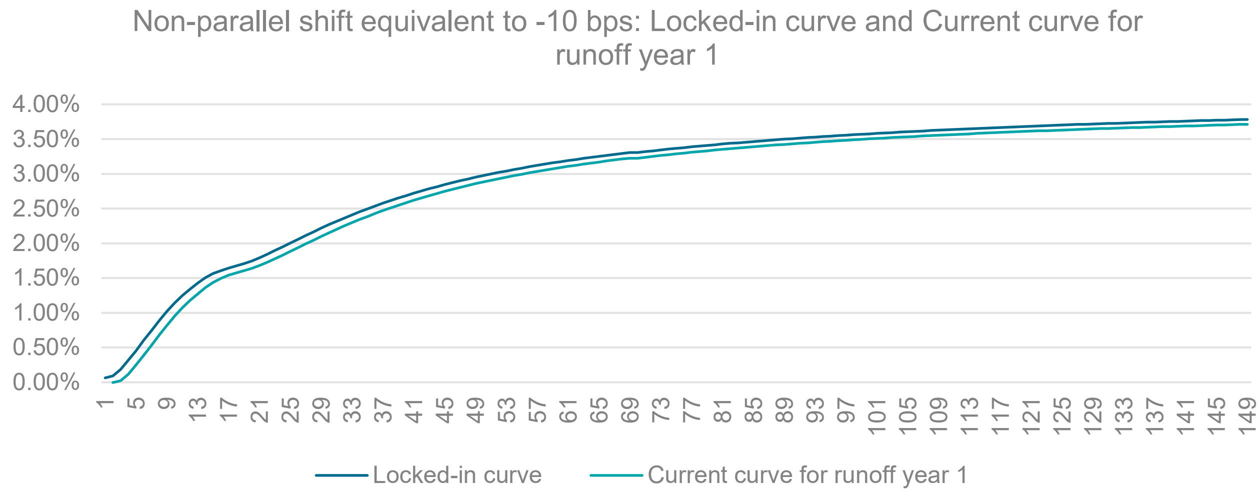


Figure 11: Non-parallel shift equivalent to -10 bps: Locked-in curve and Current curve for runoff year 1

Interest accretion

The interest accretion corresponds to the unwinding of all components of the IFRS 17 technical liabilities. The unwinding is computed based on the locked-in discount curve. It impacts the net financial result in the income statement. The equations below use the equation (3).

$$\text{For } t \geq 1,$$

The interest accretion related to the BE is equal to:

$$IA_{BE(t)} = \ BE_0(t-1) \times r_0^{fwd}(t) \ . \qquad (10)$$

The interest accretion related to the Risk Adjustment is equal to:

$$IA\_RA(t) = \ RA_0(t-1) \times r_0^{fwd}(t) \ . \qquad (11)$$

The interest accretion related to the CSM is equal to:

$$IA\_CSM(t) = \ CSM(t-1) \times r_0^{fwd}(t) \ . \qquad (12)$$

The interest accretion related to IFRS 17 technical provision is equal to:

$$\boldsymbol{IA(t) = IA\_BE(t) + IA\_RA(t) + IA\_CSM(t)}\ , \qquad (13)$$

$$\boldsymbol{IA(t) = r_0(t) \times (BE_0(t-1) + RA_0(t-1) + CSM(t-1))}\ .$$

Impact of change in interest rates on the technical liability

The impact of a change in interest rates corresponds to the impact of the update of the discount curve on the technical liabilities. Under BBA, only the BE and the Risk Adjustment are subject to this update, but the CSM is not sensitive to the change in discount curve and remains discounted with the locked-in curve.

The model assumes that the OCI option is chosen and therefore, the impact of a change in interest rates goes through the OCI. As a reminder, the assumption is driven by the average asset allocation of European insurers in 2020, where 61% of their assets under management are invested in Fixed Income (EIOPA, 2020). Under IFRS 9, the change in fair value of fixed income goes through OCI in the asset revaluation reserve.

For $t \geq 1$,

The impact of a change in interest rates on the BE is equal to:

$$Liab\_OCI\_BE_i(t) = (BE_i(t) - BE_0(t)) - (BE_i(t-1) - BE_0(t-1))\ . \qquad (14)$$

The impact of a change in interest rates on the Risk Adjustment is equal to:

$$Liab\_OCI\_RA_i(t) = (RA_i(t) - RA_0(t)) - (RA_i(t-1) - RA_0(t-1))\ . \qquad (15)$$

The impact of a change in interest rates on IFRS 17 technical provisions flowing through the OCI is equal to:

$$\boldsymbol{Liab\_OCI_i(t) = Liab\_OCI\_BE_i(t) + Liab\_OCI\_RA_i(t)}\ . \qquad (16)$$

Duration of technical liabilities

The duration is an important concept when considering sensitivity to interest rates. It is used in the model when applying the duration matching strategy between assets and liabilities.

The considered duration type is the Effective duration. As the technical cash-flows are option-free cash flows, Effective duration and Modified duration are equivalent. Those two types of duration have been chosen over the Macaulay duration because of the objective of the thesis, which is assessing the sensitivity of interest rates under IFRS 17. Effective duration and Modified duration estimate by how much the value rises or falls for a change in interest rates of 1% point. Those follow the concept that interest rates and prices change in opposite directions. While the Macaulay duration provides the weighted average time in years until all cash flows are paid. (Hull, 2018)

The Modified duration is an extension of the Macaulay duration. The model does compute the Macaulay duration for comparison with the Effective duration but is not used in the duration matching asset strategy.

$$Macaulay\ duration\ (t) = \frac{\sum_{j=t+1}^{N} \frac{j \times NTCF(j)}{(1+r_i(j))^j}}{\sum_{j=t+1}^{N} \frac{NTCF(j)}{(1+r_i(j))^j}},$$

$$Modified\ duration = \frac{Macaulay\ duration}{(1+YTM^{9})}.$$

These metrics are derived for fixed income instruments, such as zero-coupon bonds or coupon-bearing bonds. When looking at technical liability duration, these metrics may not be fully adequate. Compared to fixed income projected cash flows, technical cash flows can change signs (inflows, outflows) and have different pattern than the same coupon payment every year. In addition, under BBA, IFRS 17 has the specificity that the CSM is not sensitive to interest rates changes. However, the CSM cash flows cannot simply be excluded from the Modified duration formula. The alternative is to apply the Effective duration approach. To reflect the fact that the CSM is not sensitive to a change in interest rates, the present value of the CSM remains discounted with the locked-in curve in the Effective duration formula.

With:

Δ corresponds to a parallel shift of Δbps,

$BE_i^{+\Delta}(t)$ and $BE_i^{-\Delta}(t)$ correspond to $BE_i(t)$ with a discount curve shocked parallelly by $+\Delta$bps and $-\Delta$bps respectively,

$RA_i^{+\Delta}(t)$ and $RA_i^{-\Delta}(t)$ correspond to $RA_i(t)$ with a discount curve shocked parallelly by $+\Delta$bps and $-\Delta$bps respectively,

$TP_i^{+\Delta}(t) = BE_i^{+\Delta}(t) + RA_i^{+\Delta}(t) + CSM(t)$,

$TP_i^{-\Delta}(t) = BE_i^{-\Delta}(t) + RA_i^{-\Delta}(t) + CSM(t)$,

the Effective duration is noted as below:

$$\boldsymbol{Liab\_D_i(t)} = \frac{\boldsymbol{TP_i^{+\Delta}(t) - TP_i^{-\Delta}(t)}}{\boldsymbol{2 \times TP_i\ (t) \times \Delta}}. \qquad (17)$$

A VBA macro is built to compute the Effective duration with the change in interest rates. Based on the equation (17), the macro provides the following vector that is used for the duration matching asset strategy.

$$\{\boldsymbol{Liab\_D_1(1), Liab\_D_2(2), Liab\_D_3(3), \dots, Liab\_D_N(N)}\}. \qquad (18)$$

2.3. Interest rates sensitivity on assets backing the technical liabilities

The thesis considers an assets strategy that 'fits' IFRS 17 by looking at all components of IFRS 17 technical liabilities, i.e., the BE, the Risk Adjustment, and the CSM. Other assets strategies can be considered, such as a Solvency 2 strategy, which would look at Solvency 2 Best Estimates Liabilities and Risk Margin. Should it be applied to IFRS 17, it could be an asset strategy that considers the BE and the Risk Adjustment and leaves

[9] YTM : Yield To Maturity

out the CSM, if the Risk Adjustment is considered equivalent to the Risk Margin. A French GAAP asset strategy can also be contemplated, which would look at the technical cash flows, i.e., premiums and claims. Applying it to IFRS 17, the asset strategy would only consider the BE cash flows.

The model computes the valuation of the assets backing the technical liabilities under two approaches:
- An IFRS 17 cash flow matching strategy,
- An IFRS 17 duration matching strategy.

Both strategies consider zero-coupon bonds investment.

The following notation describes the asset yield:

$y_i(t)$	corresponds to the yield of the assets backing the technical liabilities for the reporting year i of the runoff year t.

2.3.1. IFRS 17 cash flow matching strategy

For the IFRS 17 cash flow matching approach, the asset strategy aims at matching future technical outflows. As the model applies an IFRS 17 asset strategy, the cash flows considered are all three components of IFRS 17 technical cash flows, namely the premiums and the claims, the amortization of the risk adjustment (10% of claims), and the amortization of the CSM.

The considered cash flows for the cash flow matching approach:

$NCIF(t)$	corresponds to the net technical cash inflow for the runoff year t,
$NCOF(t)$	corresponds to the net technical cash outflow for the runoff year t.

For $t \geq 1$,

$$NCIF(t) = Max(0; Premium(t) - Claim(t) - 10\% \times Claim(t) - A(t) \times CSM(t-1)),$$

$$NCOF(t) = Min(0; Premium(t) - Claim(t) - 10\% \times Claim(t) - A(t) \times CSM(t-1)). \quad (19)$$

The following notations describe the asset maturity:

T	corresponds to the first year of the net cash outflows,
k_n	corresponds to the k[th] zero-coupon bond issued in year n,
m_{k_n}	corresponds to the maturity of the k[th] zero-coupon bond issued in year n,
$Nominal_{k_n}$	corresponds to the nominal amount of the k[th] zero-coupon bond issued in year n.

The model assumes that the insurer has external funds, i.e., outside of the closed block of business considered, to invest in day-1 in zero-coupon bonds with amount and maturity that match all future outflows.

- Under this case, $n = 0$. All zero-coupon bonds are invested at inception of the portfolio. For more clarity, k_0 is noted k going forward.
- The maturity corresponds to the difference between the year of the cash outflow and the year of issuance of the zero-coupon bond:

$$m_k = T + k - 1.$$

- The nominal amount is equal to the cash outflow of the runoff year $T+k-1$ from the equation (19):

$$Nominal_k = NCOF(T+k-1).$$

The market value of the k[th] zero-coupon bond issued of the runoff year t for the reporting year i is computed as follow:

$$MV_{k,i}^{cf}(t) = \frac{Nominal_k \times (1+y_i(t-1))^{t-1}}{(1+y_i(m_k))^{m_k}}.$$

The market value of all zero-coupon bonds issued of the runoff year t for the reporting year i is computed as follow:

$$MV_i^{cf}(t) = \sum_{k=1}^{N-T+1} MV_{k,i}^{cf}(t).$$

Two components are tracked for the analysis:

- The investment return considered here as the reinvested coupons. It impacts the net financial result in the income statement.

For $t \geq 1$,

$$InvRet(t) = \sum_{k=1}^{N-T+1}(MV_{k,0}^{cf}(t) - MV_{k,0}^{cf}(t-1)).$$

- The change in the asset value due to interest rates movements. It impacts the asset revaluation reserve as part of the OCI as per IFRS 9 FVOCI.

For $t \geq 1$,

$$ChgARR_i(t) = \sum_{k=1}^{N-T+1} (MV_{k,i}^{cf}(t) - MV_{k,0}^{cf}(t)) - (MV_{k,i}^{cf}(t-1) - MV_{k,0}^{cf}(t-1)).$$

2.3.2. IFRS 17 duration matching strategy

For the IFRS 17 duration matching strategy approach, the model aims at matching the duration of the technical liabilities computed as per described in the section 2.2.2 IFRS 17: Long-term care technical liabilities, with the duration of the assets backing the technical liabilities.

The model assumes that the insurer enters into a succession of forward zero-coupon bonds to lock day-1 yield curve. This assumption is mainly to ensure that the investment return is locked at inception. In other words, when using the forward zero-coupon bonds, the model forces the investment return and the unwinding of the technical provisions to be opposite and equal.

The purchases and sales of the forward zero-coupon bonds follow the sequence describes below:

- The zero-coupon bond is assumed to be invested before establishing the annual report at the end of the period.
- For the year-end report, the zero-coupon bond needs to be valued with the year-end economic assumptions.
- The following year, the zero-coupon is sold before establishing the annual report. Simultaneously, a new zero-coupon bond is bought. It is assumed no tax, no commissions nor bid ask spread.

The invested zero-coupon bonds have the following terms:

- With the forward, the purchase price is fixed regardless the change in interest rates. The price of the k^th zero-coupon bond is equals to the technical liabilities discounted at locked-in rates of the corresponding year (equation (7)):

$$PriceZC_k = TP_0(k) .$$

- The maturity of the k^th zero-coupon bond is noted m_k. The calibration of the maturity is explained below.

- The nominal amount of the k^th zero-coupon bonds is equal to the capitalized amount of the bond price:

$$Nominal_k = PriceZC_k \times \frac{(1+y_0(m_k+1))^{m_k+1}}{(1+y_0(k)^k},$$

  $m_{k_n} + 1$ does not necessarily correspond to a full year. In order to obtain a yield while the yield curve is provided annually, a linear interpolation has been applied given by the following equation:

$$y_i(m_k+1) = y_i(\lfloor m_k+1 \rfloor) + \big((m_k+1) - \lfloor m_k+1 \rfloor\big) \times (y_i(\lfloor m_k+1 \rfloor + 1) - y_i(\lfloor m_k+1 \rfloor)) .$$

- The market value of the zero-coupon bond of the k^th zero-coupon bond issued of the runoff year t for the reporting year i is computed as follow:

$$MV_{k,i}^d(t) = Nominal_k \times \frac{(1+y_i(k))^k}{(1+y_i(m_k+1))^{m_k+1}} .$$

To be consistent with the computation of the technical liability duration, the duration of the zero-coupon bonds contemplated for the duration matching strategy is also computed using the Effective duration, instead of the Macaulay and Modified durations.

$$\boldsymbol{Asset\_D_i(t)} = \frac{\boldsymbol{MV_{i,i}^{d+\Delta}(t) - MV_{i,i}^{d-\Delta}(t)}}{\boldsymbol{2 \times MV_{i,i}^{d}(t) \times \Delta}}, \qquad (20)$$

Where Δ corresponds to a parallel shift of Δbps,

Where $MV_{i,i}^{d+\Delta}(t)$ and $MV_{i,i}^{d-\Delta}(t)$ correspond to $MV_{i,i}^{d}(t)$ but with a discount curve shocked parallelly by +Δbps and −Δbps respectively.

The model provides the following vector that is used for the duration matching asset strategy:

$$\{\boldsymbol{Asset\_D_1(1), Asset\_D_2(2), Asset\_D_3(3), \ldots, Asset\_D_N(N)}\} . \qquad (21)$$

The maturity is calibrated to minimize the duration mismatch between assets and liabilities. In the model, a VBA macro is built to goal seek the maturity of the zero-coupon bond, which minimize the duration mismatch between assets and liabilities for each runoff year. Therefore, the model takes the two duration vectors computed from the equations (18), (21), and makes the difference of the two to obtain a vector of duration mismatch.

$$\{\boldsymbol{Asset_{D_1}(1), Asset_{D_2}(2), Asset_{D_3}(3), \dots, Asset_{D_N}(N)}\}$$

$$-$$

$$\{\boldsymbol{Liab\_D_1(1), Liab\_D_2(2), Liab\_D_3(3), \dots, Liab\_D_N(N)}\}\,.$$

Two components are tracked for the analysis:

- The investment return considered here is the implicit reinvested coupons. It impacts the net financial result in the income statement, and

For $t \geq 1$,

$$InvRet(t) = MV_{t,0}^{d}(t) - MV_{t,0}^{d}(t-1)\,. \qquad (22)$$

- The change in the asset value due to interest rates movements. It impacts the asset revaluation reserve as part of the OCI as per IFRS 9 FVOCI.

For $t \geq 1$,

$$ChgARR_i(t) = (MV_{t,i}^{d}(t) - MV_{t,0}^{d}(t)) \; - \; (MV_{t,i}^{d}(t-1) - MV_{t,0}^{d}(t-1))\,. \qquad (23)$$

2.4. Assessing accounting volatility between technical liabilities and assets

In order to assess the accounting volatility related to interest rates movements between technical liabilities and the assets backing them, the sensitivity to interest rates is summarized in financial statements and financial metrics.

As both assets and liabilities are analyzed together and not separately, the technical provisions and the assets are put together in a cash flow statement, a balance sheet, and an income statement. There is a focus on the components that are sensitive to interest rates, such as the OCI and the net financial result. Although the main analysis is on IFRS 17, the model also analyzes IFRS 4 financial statements to better appreciate the change to IFRS 17.

To better fulfill the objective of the thesis, the model provides specific financial metrics that are analyzed in the Chapter 3. It includes the impact of changes in interest rates on the technical provisions, the duration mismatch between the technical liabilities and the assets backing them, the mismatch of the net financial result between the unwinding of the technical liabilities and the investment return, the change in OCI, the ratio between the change in OCI and the net income weighted with the sum assured, and the deviation of the ROE.

2.4.1. Outputs: Financial statement

Three financial statements are built in the model and are linked to each other:
- Cash flows statement,
- Balance sheet,
- Income statement.

Cash flows statement

In the model, the closing cash flows balance of the cash flows statement provides the total amount of assets in the balance sheet. It has been restricted to the components used in the thesis, therefore it does not provide the exhaustive components list that a cash flows statement would usually include, such as the acquisition expenses directly and not directly attributable, the renewal expenses, or overhead costs not directly attributable.

The figure below shows the cash flows statement extracted from the model.

Cash Flows Statement
Opening cash flow balance
Premiums Received
Expected Claims
Investment return
Unrealized Capital Gains/Losses
Closing cash flow balance

Figure 12: Output – Cash Flows Statement

Balance sheet

The balance sheet from the model splits the free assets from the assets backing the technical liabilities, as well as the OCI between the asset revaluation reserves and the OCI from the change in interest rates related to technical provisions. The shareholders' equity is equal to the cumulative sum of the net income and the sum of the change in OCI.

The figure below shows the IFRS 17 balance sheet extracted from the model.

Balance Sheet
Assets
Assets backing technical provisions
Free Assets
Technical Provisions
Best Estimates
Risk Adjustment
CSM
Shareholders' Equity
Net income (cumulative)
OCI (cumulative)
Asset revaluation reserve
OCI Liabilities (cumulative)

Figure 13: Output – Balance Sheet

Income statement

The income statement also incorporates only the components that are used in the model. It does not show components related to acquisition cost directly and not directly attributable or expenses. Also, as it is assumed that the insurer chooses the OCI option for the technical liabilities and the assets invested follow the fair value through OCI treatment, the income statement is not disclosing the impact of change in fair value of the technical liabilities nor of the financial instruments.

The figure below shows the IFRS 17 income statement with the details of the OCI extracted from the model.

Income Statement
Insurance contract revenue
Expected claims
Amortization of Risk Adjustment
Amortization of CSM
Insurance contract expenses
Claims and expenses
Claims incurred
Insurance services result
Insurance Finance Income or expenses
Interest accretion
Best Estimates
Risk Adjustment
CSM
Investment results
Investment return
Net Financial result
Net income
Cumulative Net income
Change in Asset revaluation reserve
Change in OCI related to technical provisions
Best Estimates
Risk Adjustment
Change in Other comprehensive income
Other comprehensive income
Total Net income and OCI result

Figure 14: Output – Income Statement

2.4.2. Outputs: Financial metrics

This section introduces and explains the financial metrics used in the Chapter 3 to analyze the accounting volatility related interest rates sensitivity.

Impact of a change in interest rates on technical provisions

The impact of a change in interest rates on technical provisions is compared to the technical liabilities to assess the materiality. The impact of change in interest rates on technical liabilities for a reporting year uses the equation (16). Each of the impacts in an absolute amount is then looked in proportion of the corresponding technical provisions given by the equation (7). The model provides the average percentage of impact due to interest rates relative to the volume of technical provision:

$$\frac{\boldsymbol{Liab\_OCI_i(t)}}{\boldsymbol{TP_i(t)}} \,.$$

Effective duration mismatch between the technical liabilities and the assets backing them

By using the duration matching strategy, the comparison of the durations of the technical liabilities and the assets backing them is particularly important in the analysis. The model proposes to compare them using the equations (18) and (21) to assess the residual mismatch.

$$\{\boldsymbol{Asset_{D_1}(1), Asset_{D_2}(2), Asset_{D_3}(3), \dots, Asset_{D_N}(N)}\}$$

$$-$$

$$\{\boldsymbol{Liab\_D_1(1), Liab\_D_2(2), Liab\_D_3(3), \dots, Liab\_D_N(N)}\} \,.$$

Mismatch from the net financial result

As a reminder, the net financial result is comprised of insurance finance income or expenses and investment return from assets invested.

For the thesis, it is assumed that:

- the insurer choses the OCI option to reflect the impact of change in interest rates. Therefore, the insurance finance expenses only incorporate the impact of the unwinding of the technical liability discount rates,
- the investment return only relates to the assets backing the technical liabilities. It is assumed that the free assets, i.e., not backing the technical liabilities from excess premium above technical liabilities, do not bear any return. Those assets could have been invested in cash and would have return the risk-free for example. It was chosen to leave out the free assets in the investment return to avoid extra-noise as the objective of the thesis being to analyze the mismatch in a closed block of business of the technical liabilities and the assets backing them.

The metric is computed as follow with the equations (13) and (22):

$$\boldsymbol{InvRet(t) - IA(t)} \,.$$

Change in OCI related to interest rates movements

The change in OCI is the difference between the change in asset revaluation reserve and the change in OCI related to technical liabilities. This metric is crucial to analyze to which extent the impact of a change in interest rates is offset between technical liabilities and assets. It uses the equations (16) and (23) as follow:

$$\boldsymbol{ChgARR_i(t) - Liab\_OCI_i(t)}\,.$$

The overall average of the change in OCI is always equal to zero as the sum of the change in OCI over the entire projection period is equal to zero. However, the standard deviation is interesting to be analyzed to assess the volatility of the change in OCI.

Ratio between the change in OCI and the net income weighted with the sum assured

The ratio is computed for each runoff year using the equations (16) and (23) as follow:

$$\frac{\boldsymbol{ChgARR_i(t) - Liab\_OCI_i(t)}}{\boldsymbol{Net\ Income(t)}} \times \frac{\boldsymbol{SA(t)}}{\boldsymbol{SA(0)}}\,.$$

The ratio is weighted with the sum assured to give more weight to years where the portfolio has the highest sum assured.

This ratio provides a good assessment on the materiality, but also the volatility of the change in OCI. If there are no interest rates movements or if the movements are offsetting each other between technical liabilities and assets, the ratio is equal to zero over the projection period. It is interesting to have the average to assess the overall impact and the standard deviation to assess the volatility of the ratio over the period.
It is worth noting that should the OCI option is not chosen, this ratio would reflect the change in net income related to interest rates movements.

Deviation of the ROE compared to the base case scenario

The ROE is one of the main KPI used in the insurance industry to assess the profitability of a company. It is computed as follow in the model:

$$\frac{\boldsymbol{Net\ income(t)}}{\boldsymbol{Average\ Shareholders'\ Equity}}\,.$$

The Shareholders' equity is comprised of the cumulative net income and the cumulative change in OCI. Therefore, the Shareholders' equity is sensitivity to any movements from the change in OCI, and the net income to any mismatch from the net financial result.

Based on the projected sequence of the returns on equity without any movements in interest rates, the model analyzes the deviation of the ROE for the different scenarios considered.

All these financial metrics presented above are used in the Chapter 3 to analyze the results of the model from the different scenarios considered. Most of those financial metrics are presented into charts and tables format.

2.5. Presentation of the scenarios considered for the sensitivity analysis

This section aims at introducing the scenarios considered for the sensitivity analysis that is detailed in the first sections of the Chapter 3. The scenarios that have been chosen for the thesis do not aim to provide an exhaustive list of possible cases but rather focus on the understanding of the sensitivity to interest rates for different asset and liability management strategies and different interest rates movements.

2.5.1. Appraisal of IFRS 4

The appraisal of the sensitivity to interest rates under IFRS 4 serves as a basis for comparison when analyzing IFRS 17 sensitivity. The particularity of this case is that technical liabilities are discounted with a flat curve at 1.50% and is not updated throughout the runoff period. For the assets backing the technical liabilities, a parallel shift of the projected curves is applied. In terms of asset and liability management strategy, the appraisal only considers a duration matching strategy.

2.5.2. Scenario Base Case: No interest rates movements

Scenario Base Case is built under IFRS 17 and as its name stands for, it serves as a comparison basis for all other scenarios. The main assumption of the scenario is that there are no movements of interest rates compared to the initial interest rates curve used on day 1.

Should IFRS 17 remove the accounting volatility as explained in section 1.3.2 The objective of the thesis relies on the objectives set by IFRS, it is expected that when the scenarios introduce interest rates movements, it would result in no to small deviations compared to a scenario without interest rates movements. Therefore, the sensitivity to interest rates is analyzed by deviation from Scenario Base Case.

Two asset and liability management strategies are contemplated for IFRS 17, a cash flow matching strategy and a duration matching strategy.

2.5.3. IFRS 17 Cash flow matching strategy

The cash flow matching strategy is explained in the section 2.3.1 IFRS 17 cash flow matching strategy. The model considers zero-coupon bonds and provides the valuation and the investment return for each runoff year and reporting year. The redemption of zero-coupon bonds would match the technical cash outflows.

The considered cash flows are all three components of IFRS 17 cash flows to compute the technical liabilities, namely the technical cash flows, the amortization of the Risk Adjustment (10% of claims), and the amortization of the CSM.

The cash flow matching scenario introduces interest rates movements with a parallel shift. The interest rates movements introduced in the scenario are parallel-shift compared to the locked-in curve. The computation of the current discount curves is explained in the section 2.2.2 IFRS 17: Long-term care technical liabilities. However, the same yield curves are used for the investment return and for the discounting of the technical provisions. The parallel shift considered for Scenario 1 consists of a decrease of -10 bps for all maturities and for all reporting year.

2.5.4. IFRS 17 Duration matching strategy

For the IFRS 17 duration matching strategy approach, the model aims at matching the duration of the technical liabilities with the duration of the assets backing the technical liabilities, as described in 2.3.2 IFRS 17 duration matching strategy.

The duration matching introduced two types of interest rates movement, a parallel shift and a non-parallel shift, described as Scenario 1 and Scenario 2 respectively.

Scenario 1: Parallel shift interest rates movements

Scenario 1 adds interest rates movements, but the same yield curves are used for the investment return and for the discounting of the technical provisions. The interest rates movements introduced in the scenario are parallel-shift compared to the locked-in curve. The computation of the current discount curves is explained in the section 2.2.2 IFRS 17: Long-term care technical liabilities. The parallel shift considered for Scenario 1 consists of a decrease of -10 bps for all maturities and for all reporting year.

Scenario 2: Non-parallel shift interest rates movements

Scenario 2 also includes interest rates movements and as well uses the same yield curves for the investment return and for the discounting of the technical liabilities. However, the movements apply a non-parallel shift to the curves compared to the locked-in curve. The computation of the current discount curves is explained in the section 2.2.2 IFRS 17: Long-term care technical liabilities. The non-parallel shift considered for Scenario 2 consists of a 1-year shift of the locked-in curve plus a spread $s = -0.06715\%$.

For both scenarios, a sub-scenario is contemplated to include a maturity limit for the invested assets. The longest subset index available for euro corporate bonds by ICE BofA Euro Corporate Index[10] is the ICE BofA 10+ Year Euro Corporate Index[11]. The factsheet as of 15.11.2015[12] shows an average maturity of 13 years. Therefore, the maximum maturity uses in the sub-scenario is 13 years. The scenario including the maturity limitation is to reflect the market liquidity and deepness that are not the same for a duration of 10 years and a duration of 30 years and above, such as the duration for long-term care portfolio.

[10] ICE BofA Euro Corporate Index tracks the performance of EUR denominated investment grade corporate debt publicly issued in the eurobond or Euro member domestic markets.
[11] ICE BofA 10+ Year Euro Corporate Index is a subset of ICE BofA Euro Corporate Index including all securities with a remaining term to final maturity greater than or equal to 10 years.
[12] Appendix 6: ICE BofA 10+ Year Euro Corporate Index

2.5.5. Summary of the assumptions taken for the different scenarios for IFRS 17

The table below summarizes the scenarios considered for the analysis of the accounting volatility.

Assumptions	IFRS 4 appraisal	Scenario Base case	Cash flows matching	Duration matching	
				Scenario 1	Scenario 2
Technical liabilities Locked-in discount curve	1.50% flat	EIOPA with VA as of 31.12.2015	EIOPA with VA as of 31.12.2015	EIOPA with VA as of 31.12.2015	EIOPA with VA as of 31.12.2015
Shock applied to discount curve for projected years	No changes	No changes	Parallel shift of -10 bps	Parallel shift of -10 bps	Non-parallel shift (curve shifted)
Investment yield curve	EIOPA with VA as of 31.12.2015	EIOPA with VA as of 31.12.2015	EIOPA with VA as of 31.12.2015	EIOPA with VA as of 31.12.2015	EIOPA with VA as of 31.12.2015
Shock applied to investment yield curve	Parallel shift of -10 bps	No changes	Parallel shift of -10 bps	Parallel shift of -10 bps	Non-parallel shift (curve shifted)
Max maturity of invested bonds	No limit	No limit	No limit	No limit / 13 years	No limit / 13 years

Table 2: Summary of assumptions taken for the scenarios

The Chapter 2 has presented the model that has been built to fulfill the objective set by the thesis of assessing to what extent IFRS 17 removes or reduces the accounting volatility between the valuation of the technical liabilities and the assets backing them. The assumptions taken for the contemplated scenarios have been presented and described to analyze the results in the Chapter 3.

3. Analysis of the results

The third and final chapter of the thesis focuses on the analysis of the accounting volatility between the valuation of the technical liabilities under IFRS 17 and the assets backing them. The analysis is based on a sensitivity approach, i.e., based on deviations compared to Scenario Base Case.

As an introduction of the analysis, the chapter provides an appraisal of the sensitivity under IFRS 4 in order to better appreciate the change to IFRS 17.

The sections are then addressing the sensitivity to interest rates under IFRS 17 through two asset and liability management strategies, a cash flow matching and a duration matching.

- The approach with a cash flow matching strategy contemplates a parallel shift of the projected curves as described in 572.5 Presentation of the scenarios considered for the sensitivity analysis.
- The approach with a duration matching strategy contemplates both a parallel and a non-parallel shift of the projected curves as described in 572.5 Presentation of the scenarios considered for the sensitivity analysis.

These two sections are using the financial statements and financial metrics described in the section 2.4 Assessing accounting volatility between technical liabilities and assets.

The chapter is ending with a discussion to which extend IFRS 17 is fulfilling its objective to remove or reduce the accounting volatility between the valuation of assets and technical liabilities with the update of the discount curves. The section is providing an overall wrap-up of the case study and its limitations to fulfil the objective set by the thesis. Finally, the chapter is also providing the implications of such a sensitivity to interest rates for the insurance industry and the financial markets.

3.1. Appraisal of IFRS 4's sensitivity to interest rates

Although the thesis is not a focus on IFRS 4, looking at the sensitivity to interest rates under IFRS 4 allows to have a better appreciation of the change to IFRS 17. The analysis does not cover all scenarios that have been set for IFRS 17. The appraisal for IFRS 4 compares a scenario without interest rates movements, similar to the Scenario Base Case presented for IFRS 17, with a scenario, which introduces interest movements. The movements considered are a parallel shift, like Scenario 1 for IFRS 17.

As a reminder, IFRS 4, which follows the treatment of French GAAP, does not require the technical liabilities to be at fair value, i.e., the discount rate is not required to be updated after inception of the contract. For the purpose of the thesis, it is assumed that the discount rate is not updated over the runoff period of the portfolio. The flat discount curve is set at 1.50%. It has been modified for confidentiality reasons.
The model projects the provisions for increased risk and the provisions for incurred claims, and those projections do not move over the runoff period.

The asset strategy considered for the appraisal is the duration matching strategy. The cash flow matching strategy is not analyzed for IFRS 4 appraisal.

On the assets side, the EIOPA discount curve with Volatility Adjustment as of 31/12/2015 is used at inception to compute the investment return. The curve is then shifted with the parallel shift methodology explained in the section 2.2.2 IFRS 17: Long-term care technical liabilities to compute the valuation of the assets. The change in those valuations is accounted in the asset revaluation reserve.

The chart below shows the change in OCI and the ratio between change in OCI and the net income weighted with the sum assured over the runoff period. The change in OCI has a standard deviation of around €1.9 million (m) with a maximum at around €4.5m and a minimum at -€2m.

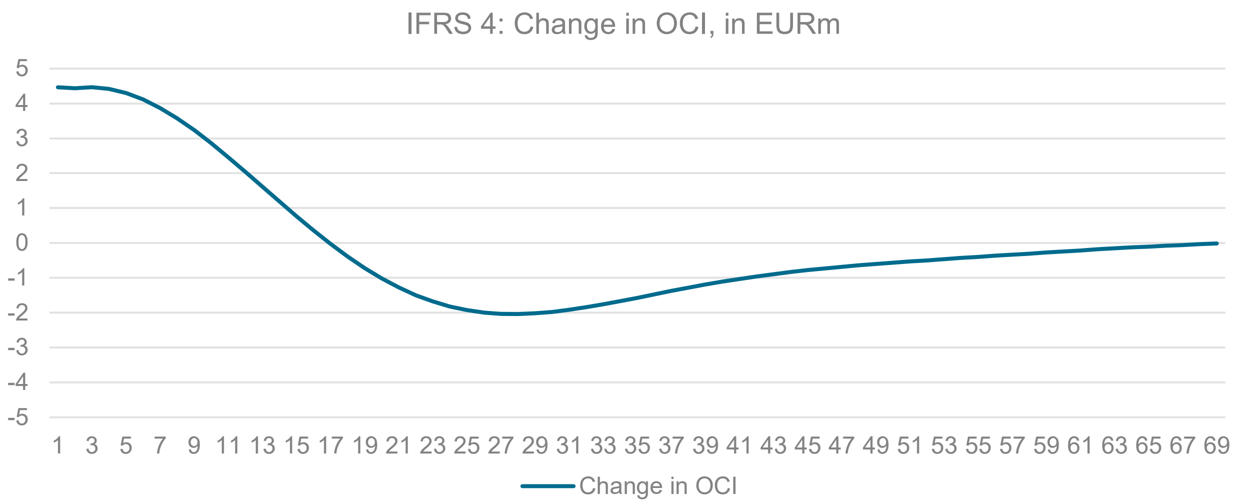


Figure 15: IFRS 4 – Change in OCI

3.2. Scenario Base Case: No interest rates movements

Scenario Base Case corresponds to the scenario where there are no interest rates movements compared to day-1 assumptions.

3.2.1. Technical provisions

The projection of the technical liabilities shows the usual pattern of long-term care business, where the technical provisions are building-up in the first decade or so corresponding to the premiums that are flowing-in without having to pay claims. The technical provisions then gradually decrease with the claims being paid and policyholders getting older.

The chart below shows the projections of the IFRS 17 technical liabilities with the three components, BE, Risk Adjustment and CSM. The technical liabilities are building-up to year 15, before starting to decrease.

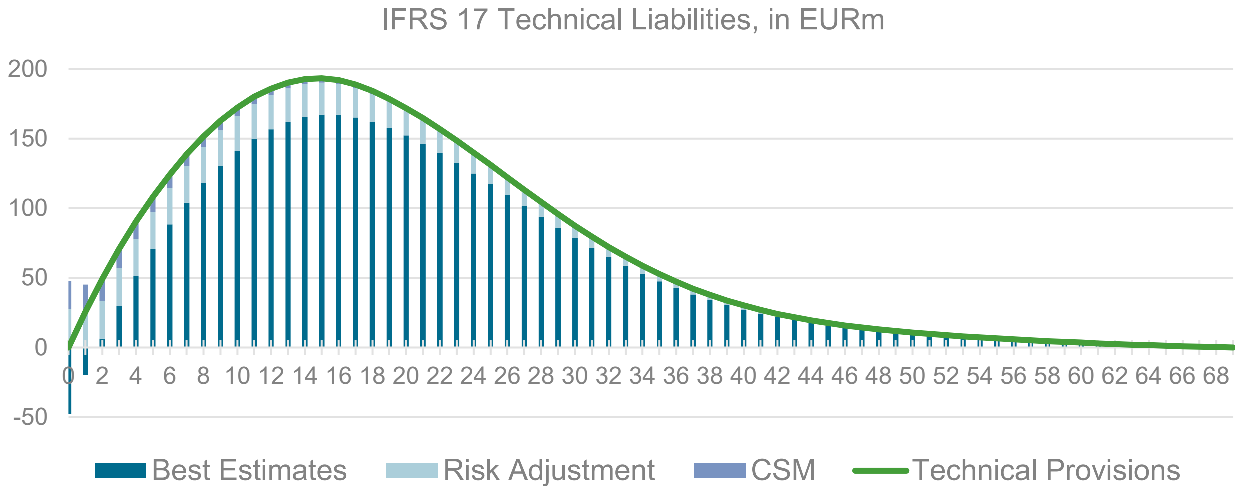


Figure 16: Scenario Base Case – IFRS 17 Technical Liabilities

The interest accretion from the technical liabilities is computed as explained in the section 2.2.2 IFRS 17: Long-term care technical liabilities.

The chart below shows the contribution of each component of the technical liabilities to the interest accretion. The movements between year 14 and year 20 (decrease, increase and decrease) is related to the 1-year forward rate, which is slightly decreasing in year 15 before increasing in year 17, and reaching the same level as per year 14 in year 20[13].

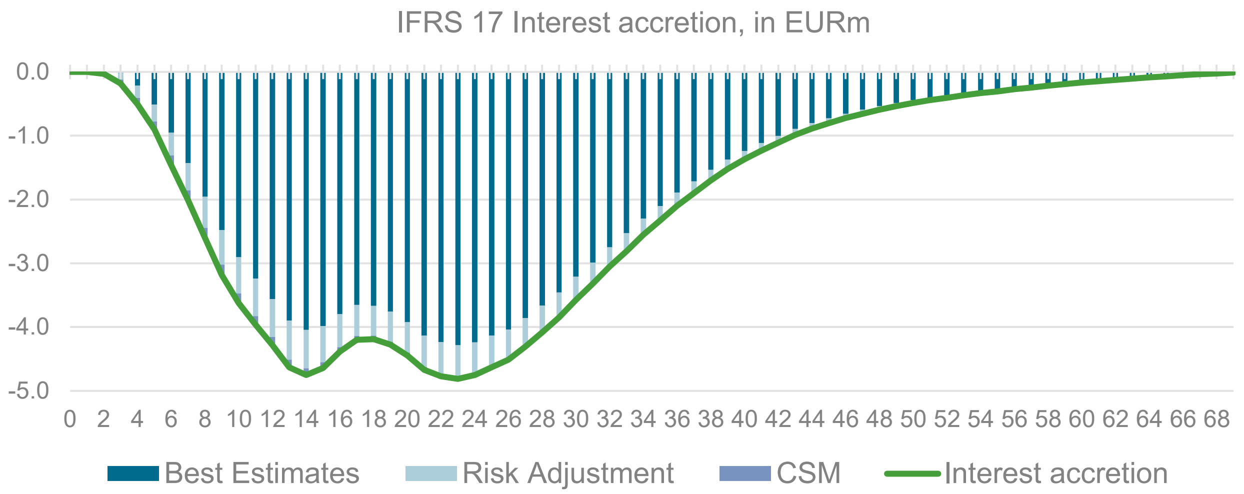


Figure 17: Scenario Base Case – IFRS 17 Interest accretion

[13] Appendix 4: EIOPA discount curve with Volatility Adjustment – spot and forward rates

3.2.2. <u>Financial metrics</u>

As the main assumption of Scenario Base Case is that there is no change in interest rates compared to day 1, nor for the technical liability discount curve, nor for the investment yield, this scenario is bearing no interest rates sensitivity. In other words, there is no impact on the OCI, and no mismatch between the interest accretion from technical liabilities and investment return from the assets backing them. Therefore, when assessing Scenario 1 and Scenario 2, the comparison basis is a deviation compared to zero for those metrics.

For the following two financial metrics assessed, Scenario Base Case is also serving as a basis:

Ratio between the change in other comprehensive income and net income weighted with the sum assured

As Scenario Base Case assumes no changes in interest rates, there is no change in OCI related to interest rates. Therefore, the ratio is equal to zero over the entire projection period.

Deviation of the Return on Equity compared to Scenario Base Case

The projected sequence of the ROE of Scenario Base Case serves as the baseline for the rest of the analysis.

The shareholders' equity is comprised of the net income of the year, the change in OCI of the year, the cumulative net income of prior years and the cumulative of the change in OCI of prior years.

The model is looking at a closed book of business and the net income is assumed to be earned at year-end. At inception, there is no shareholders' equity, and at the end of year 1, it is exactly equal to the net income of year 1. That is why the first year ROE is equal to 100%.

The average ROE over the runoff period stands at 5.7% and the standard deviation of the ROE is at 13.8%.

The chart below shows the projection of the ROE and the details of the shareholders' equity and the net income. The emergence of net income (dark green bars) is smoothly spread throughout the runoff period.

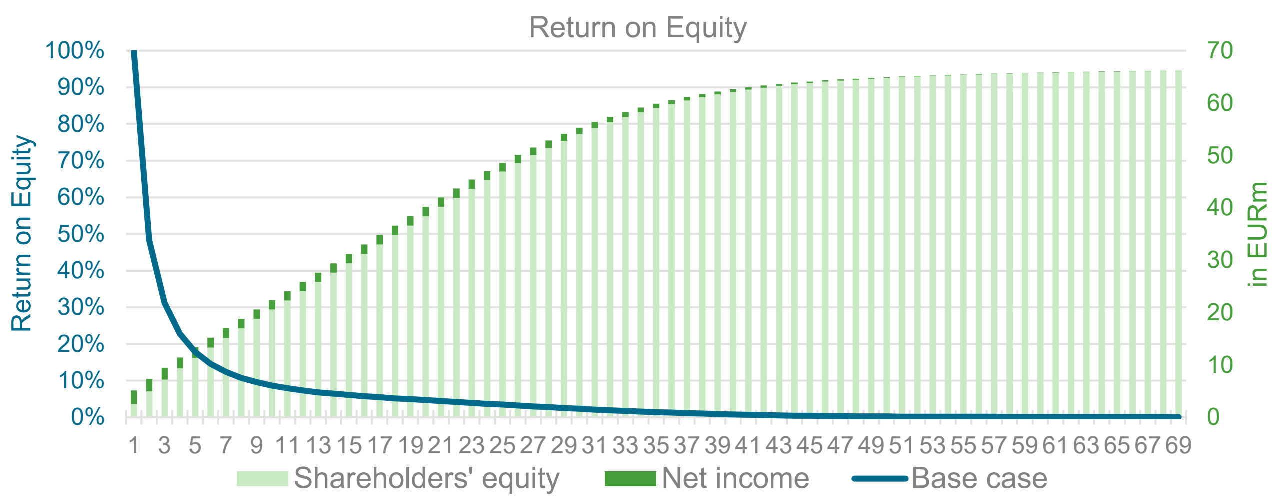


Figure 18: Base Case Scenario – Return on Equity

3.3. Analysis of a parallel shift scenario under a cash flow matching strategy

The scenario analyzed in the section introduces interest rates movements with a parallel shift under a cash flow matching strategy.

3.3.1. Cash flows considered

As explained in the section 2.3.1 IFRS 17 cash flow matching strategy, the considered cash flows are all three components of IFRS 17 cash flows to compute the technical liabilities, namely the technical cash flows, the amortization of the Risk Adjustment (10% of claims), and the amortization of the CSM. While the technical cash flows are actual flows, the amortization of the Risk Adjustment and the amortization of the CSM are only computed for IFRS 17 purposes and do not actually flow in or out of the insurer.

For the IFRS 17 cash flow matching approach, the asset strategy aims at matching future technical outflows only. The pattern of the considered net cash flows of the thesis is:

- For the first 12 years, the net cash flows are inflows,
- From the year 13 on, the net cash flows are outflows.

Therefore, the assessment of the mismatch is starting from year 13 on.

The chart below shows the net technical cash flows considered for the scenario with cash flow matching strategy. The first 12 years are cash inflows when the insurer is mainly receiving premiums to build the technical provisions. After year 13, the cash outflows correspond to the policyholders getting older and being on claims.

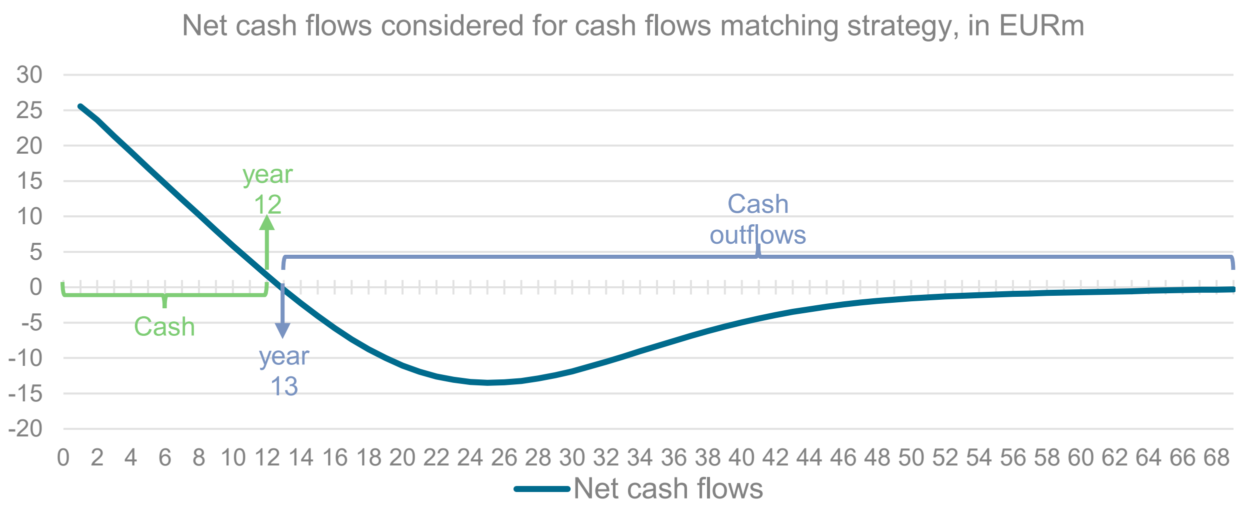


Figure 19: Cash flows matching strategy – Net cash flows considered

3.3.2. Mismatch from the net financial result

The interest accretion from technical liabilities is computed as explained in section 2.2.2 IFRS 17: Long-term care technical liabilities. All three components of the technical liabilities are subject to interest accretion and computed at locked-in rates.

The investment return is computed as explained in section 2.3.1 IFRS 17 cash flow matching strategy with the first year of net cash outflow $T = 13$. All zero-coupon bonds being invested at inception have the same yield curve than the discount curve of the technical liabilities. The scenario is built to achieve a perfect match between interest accretion and investment return.

3.3.3. Impact of change in OCI related to interest rates movements

The impact of a change in interest rates is computed as per explained in section 2.3.1 IFRS 17 cash flow matching strategy with the first year of net cash outflow $T = 13$.

As a reminder, under BBA, only the BE and the Risk Adjustment are sensitive to the update of the discount curve at each reporting year. The results of the model show a residual mismatch on the impact of a change in interest rates between the valuation of technical liabilities and the assets backing them. It appears that this mismatch is exactly equal to a theoretical impact of a change in interest rates on the CSM, should it be sensitive to those movements. It is explained by the fact that the cash flows considered for the assets include all three components of the technical liabilities. Therefore, the assets backing the technical liabilities do not distinguish the portion from the CSM and considered it as sensitive to interest rates, which is not the case on the liability side.

The chart below shows the projection of the residual mismatch between the valuation of technical liabilities and the valuation of the assets backing them. It also shows the theoretical impact of the change in interest rates on the CSM, should it be sensitive. The chart shows that those two components are offsetting each other.

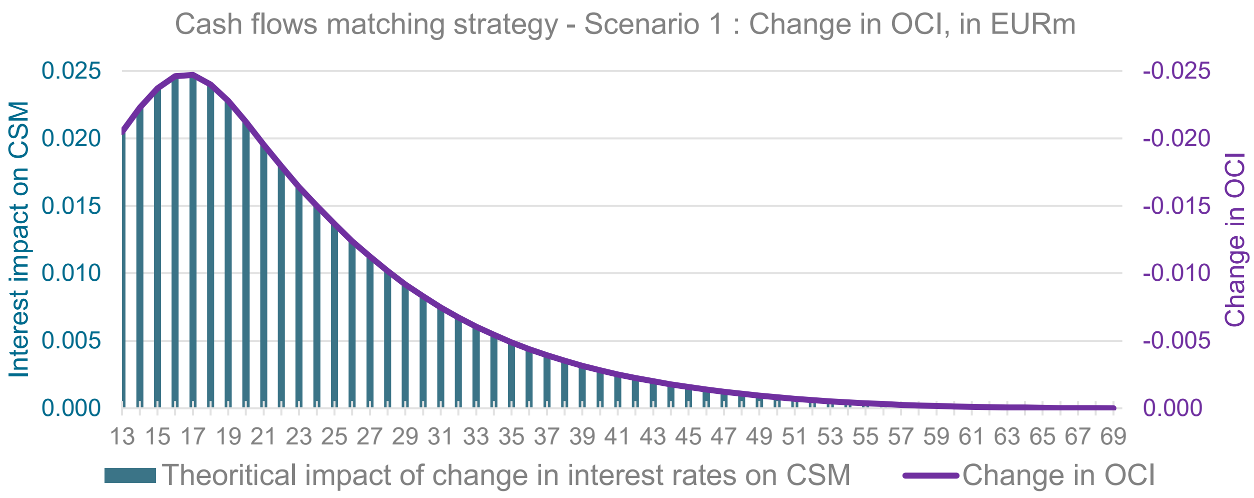


Figure 20: Cash flows matching strategy – Scenario 1 – Change in OCI

3.3.4. Assessment of accounting volatility related to interest rates

As introduced in the section 2.3 Interest rates sensitivity on assets backing the technical liabilities, the cash flow matching strategy that has been described and analyzed above can be considered as 'IFRS 17 compliant'.

Two variants can also be considered: a cash flow matching, which leaves out the CSM and a cash flow matching, which leaves out both the Risk Adjustment and the CSM.

Cash flow matching strategy, which leaves out the CSM

This strategy can be assimilated to a 'Solvency 2 compliant' strategy, should the Risk Adjustment be assumed similar to the Risk Margin. On the one hand, the change in OCI would be equal to zero, i.e., there would be no residual mismatch as the mismatch described in the 'IFRS 17 compliant' strategy was due to the CSM. However, on the other hand, the investment return would be generated from a portion that excludes the CSM, while the unwinding of the technical liabilities is affecting all three components. Therefore, there would be a mismatch on the net financial result, which would exactly correspond to the interest accretion related to the CSM.

Cash flows leaving out both the CSM and the Risk Adjustment

This variant would be closer to a 'French GAAP compliant' strategy. This strategy would only consider the actual cash flows that are flowing in and out an entity. The residual mismatch on the change in OCI would be greater than the 'IFRS 17 compliant' strategy as not only there would be residual mismatch from the theoretical impact of the change in interest rates related to the CSM, but it would also include the impact of the change in interest rates related to the Risk Adjustment. On the net financial result, the investment return would be generated only from the BE cash flows, while the unwinding of the technical liabilities is affecting all three components of the technical liabilities. The mismatch on the net financial result would correspond to the interest accretion related to the CSM and the Risk Adjustment.

Therefore, there is a choice that an insurer needs to make in terms of asset and liability management strategy to either prioritize IFRS, Solvency 2, or French GAAP. There is not fundamentally a wrong choice to pick one or the others as it depends more on the strategy of the insurance company and how the entity communicates on it. This aspect is further discussed later in the section 3.5 Is IFRS 17 fulfilling its objectives?.

3.4. Analysis of a parallel and non-parallel shift scenarios under a duration matching strategy

As a reminder, Scenario 1 and Scenario 2 introduce interest rates movements with a parallel shift and a non-parallel shift respectively.

To better appreciate the term structure of the two approaches, the model compares the yield curves at each runoff year by making the difference between the non-parallel shift curves and the parallel shift curves at the corresponding maturity of the portfolio duration.

The chart below shows the term structure comparison of the parallel and non-parallel shift. For the first twenty years, the interest rates are similar, therefore the excess return is almost negligeable. The non-parallel shifted curves turn negative earlier than the parallel shifted curves. It results in higher deviations from that point on. Overall, it shows that the non-parallel shift has a lower yield for the considered portfolio in average of -60bps compared to parallel shift.

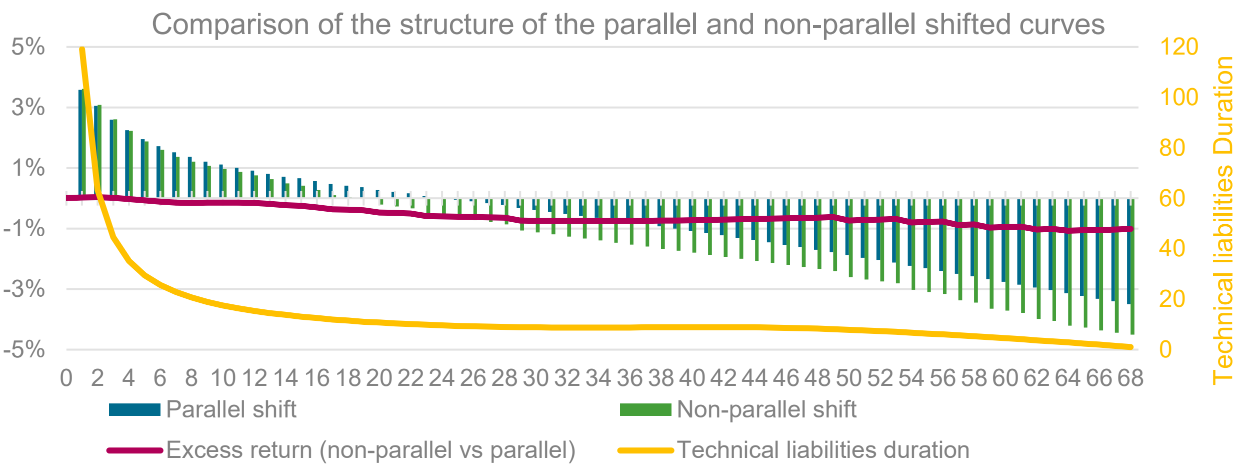


Figure 21: Comparison of the structure of the parallel and non-parallel shifted curves

3.4.1. Technical liabilities and the impact of change in interest rates

The impact of a change in interest rates is computed as per explained in section 2.4.2 Outputs: Financial metrics.

The chart below shows the projections of the change in OCI related to IFRS 17 technical provisions with Scenario 2 (green bars) having a higher impact than Scenario 1 (blue bars).

In Scenario 1 for a change in -10bps every year, the impact (blue bars below) represents in average around 3.0% of the total technical provisions.

Scenario 2 does not have a constant shock as the curves are non-parallelly shifted, but the shift has been calibrated to achieve an overall equivalent of -10bps as per the parallel shift. The impact is higher than Scenario 1 and represents in average around 4.2% of the total technical provisions.

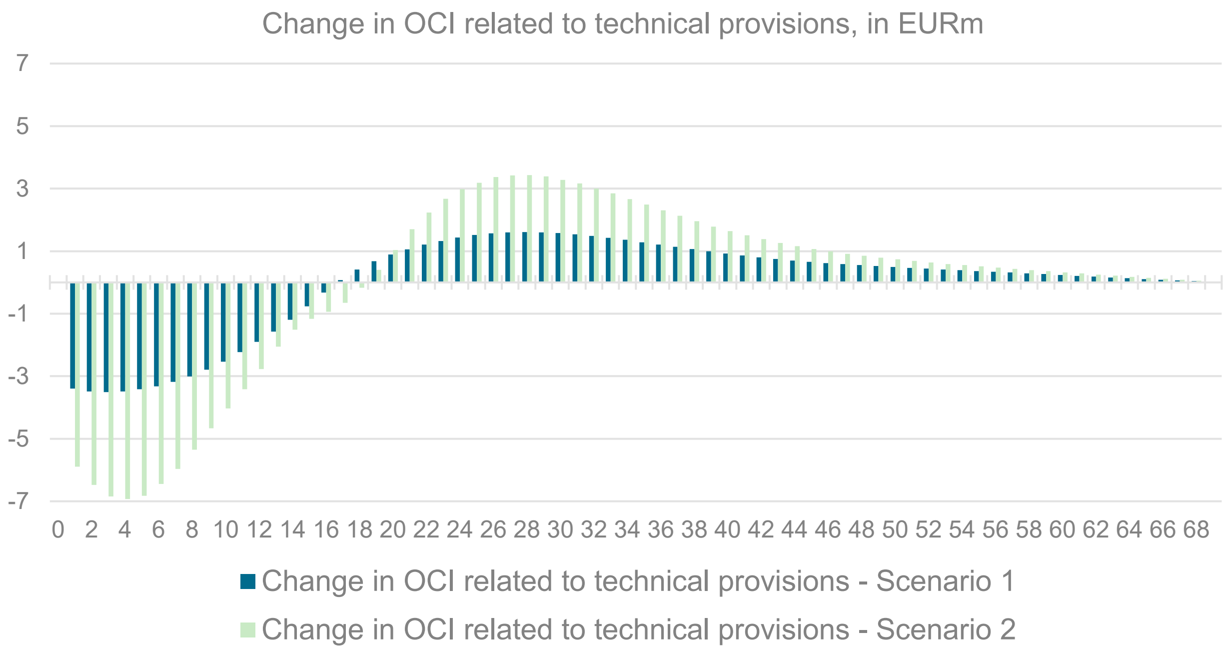


Figure 22: Duration matching strategy – Scenario 1 versus Scenario 2 – Change in OCI related technical provisions

3.4.2. Effective duration of the technical liabilities and assets backing them

The model with the zero-coupon bonds approach is able to achieve a close duration matching between technical liabilities and the assets backing them when there is no maturity limit applied to the invested assets for both scenarios.

The chart below shows the effective duration of the technical liabilities (blue bars), with the effective duration of the assets invested without (pink line) and with maturity limit (yellow line).

For both Scenario 1 and Scenario 2, the technical liabilities durations are similar, it starts relatively high at around 120 years. It then drops relatively fast to around 20 years in year 8, before gradually decreasing to around 10 years and stabilizing at this level for around 30 years, and finally decreasing again at the tail of the projections.
When a limitation on the maturity is applied, it translates into a wider duration mismatch as it prevents the assets to match the high duration of the technical liabilities. The mismatch is at around 21 and 27 years in average for the first 13 years respectively for Scenario 1 and Scenario 2 when the maturity is capped at 13 years.

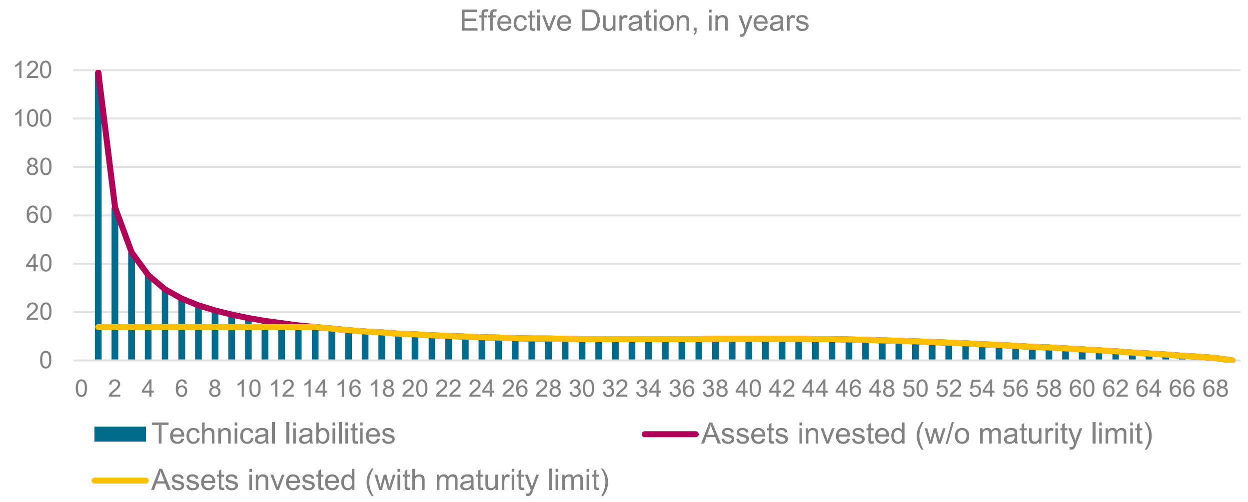


Figure 23: Duration matching strategy – Effective duration

3.4.3. Mismatch of the net financial result

The model has assumed that the initial yields are locked thanks to the purchase of forwards, and that the technical provisions are discounted using the same yield curve at locked-in. Therefore, the interest accretion from technical liabilities and the investment return from the assets backing them have been built to exactly match regardless the maturity of the financial instruments considered.

3.4.4. Change in OCI related to interest rates movements

In Scenario 1, with the duration matching strategy and the zero-coupon bonds considered, and with the relatively small parallel shift applied, the movements due to the change in interest rates from the technical liabilities and the assets backing them are well offsetting each other. It results in almost no movements on the OCI. To compare with IFRS 4, the standard deviation of the change in OCI of Scenario 1 stands at €111 thousand (k), when it was at €1.9m for IFRS 4 sensitivity. In terms of materiality, the change in OCI represents around 13% of the impact of changes in interest rates related to technical provisions.

In Scenario 2, even though the model is able to achieve a duration match between the technical liabilities and the assets backing them, mismatches in the OCI appear. The standard deviation of the change in OCI stands at €633k, it is six times higher than Scenario 1, but it still remains low compared to IFRS 4. Also, when the parallel shift was showing a residual change representing 13% of the impact of changes in interest rates related to technical provisions, this percentage jumps to 36% (+23% points) with the non-parallel shifted curves.

This is related to the shock applied to the curves being non-parallel. The sensitivity of change in interest rates using effective duration assumes an approximation that the change is linear when the price curve is actually not linear. However, for small and identical changes in yield, such as a parallel shift, the curvature or convexity error is usually small. The non-parallel shift implies a price function to be very different from what the duration value may imply.

In order to provide some perspectives in the efficiency of the duration matching strategy, the model also consider the assets only invested in cash resulting in no movements in the asset revaluation reserve. It results in higher impact of the change in OCI and a higher volatility on the change in OCI.

- For Scenario 1, the standard deviation of the change in OCI jumps to €1.5m compared to €111k under the duration matching strategy.
- For Scenario 2, the standard deviation of the change in OCI jumps to €2.8m compared to €633k under the duration matching strategy. Therefore, even though the duration matching strategy does not fully remove the volatility of the change in OCI, it still reduces it significantly.

The table below summarizes the results mentioned above for the standard deviation of the change in OCI and the average proportion of the change in OCI compared to the change in OCI related to technical provisions.

	Standard deviation of Change in OCI			**Average of Change in OCI / Change in OCI related to technical provisions**		
In EUR	**Duration matching**	**Cash investment**	***Variation***	**Duration matching**	**Cash investment**	***Variations***
Scenario 1 without maturity limit	111,363	1,532,185	*+1,420,822*	13.2%	100.0%	*+86.8% pts*
Scenario 2 without maturity limit	633,272	2,843,593	*+2,210,321*	35.7%	100.0%	*+64.3% pts*
Variations	*+521,909*	*+1,311,408*		*+22.5% pts*	*+0.0% pts*	

Table 3: Duration matching strategy – Scenario 1 versus Scenario 2 – Change in OCI and Proportion of change in OCI compared the change in OCI related to technical provisions

The chart below shows the projection for Scenario 1 of the change in OCI (pink line) with the details on the change in asset revaluation reserve (green bars) and the change in OCI related to technical liabilities (blue bars). The change in OCI is very close to zero, there is almost no residual volatility.

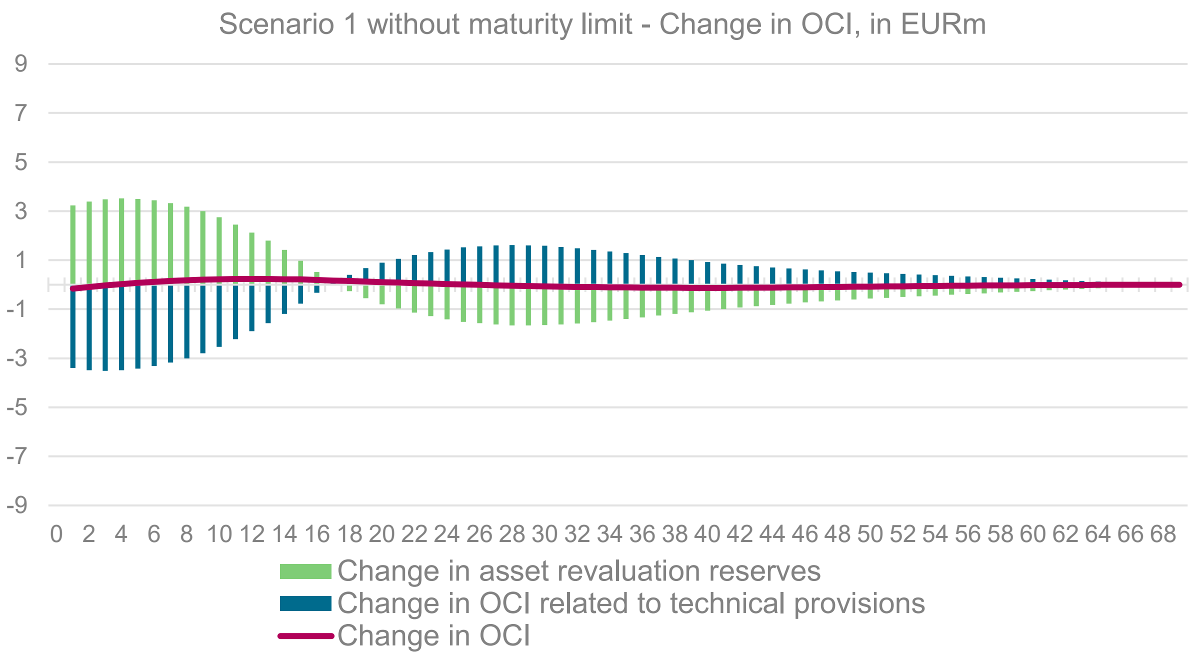


Figure 24: Duration matching strategy – Scenario 1 without maturity limit – Change in OCI

The chart below shows the projection for Scenario 2 of the change in OCI (pink line) with the details on the change in asset revaluation reserve (green bars) and the change in OCI related to technical liabilities (blue bars). The change in OCI is volatile over the runoff period but particularly during the first 25 years.

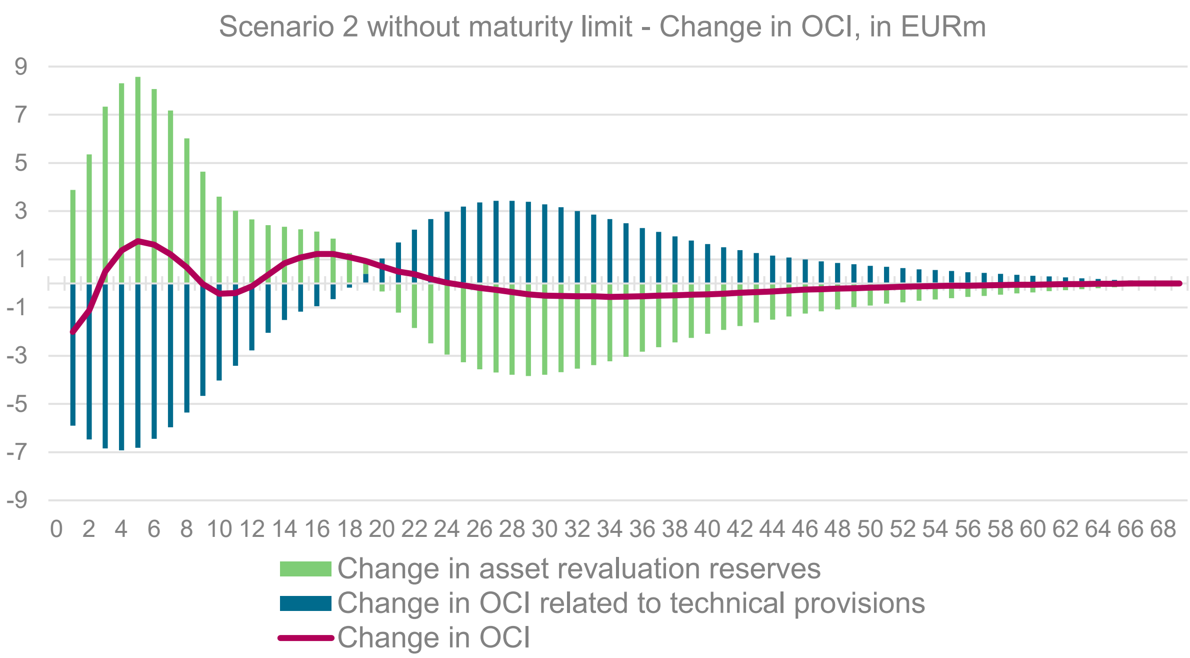


Figure 25: Duration matching strategy – Scenario 2 without maturity limit – Change in OCI

The model introduces a maturity limit at 13 years for both Scenario 1 and Scenario 2. As mentioned in the section 3.4.2 Effective duration of the technical liabilities and assets backing them, the duration mismatch was at around 21 and 27 years in average for the first thirteen years respectively for Scenario 1 and Scenario 2 when the maturity of the invested assets is capped at 13 years.

For Scenario 1, the standard deviation of the change in OCI increases to €817k compared to €111k without maturity limit. In terms of materiality, the change in OCI represents more than 30% of the change in OCI related to technical provisions. It is in the range of Scenario 2 without maturity limit, but it is 19% points higher than the ratio in Scenario 1 without maturity limit.

For Scenario 2, the standard deviation of the change in OCI increases to €1.6m compared to €633k without maturity limit. In terms of materiality, the change in OCI represents around 57% of the change in OCI related to technical provisions. It is 22% points higher than the ratio without maturity limit.

Overall, the proportion of the change in OCI over the impact of the change in interest rates on the technical liabilities increases in the same range with the maturity limit on Scenario 1 and Scenario 2 (around 20% points). The volatility of the change in OCI with the maturity limit increases by around €700k for the Scenario 1 and by around €900k for Scenario 2.

The table below summarizes the standard deviation of the change in OCI with and without maturity limit.

	Standard deviation of Change in OCI		
In EUR	**Without maturity limit**	**With maturity limit**	***Variation***
Scenario 1 without maturity limit	111,363	816,609	*+705,246*
Scenario 2 without maturity limit	633,272	1,557,508	*+924,236*
Variations	*+521,909*	*+740,899*	

Table 4: Duration matching strategy – Scenario 1 versus Scenario 2 with and without maturity limit – Standard deviation of change in OCI

The table below summarizes the change in OCI average ratio between the change in OCI and the change OCI related to technical provisions with and without maturity limit.

	Average of Change in OCI / Change in OCI related to technical provisions		
	Without maturity limit	**With maturity limit**	***Variations***
Scenario 1	13.2%	32.4%	*+19.2% pts*
Scenario 2	35.7%	57.3%	*+21.6% pts*
Variations	*+22.5% pts*	*+24.9% pts*	

Table 5: Duration matching strategy – Scenario 1 versus Scenario 2 with and without maturity limit – Average of Change in OCI / Change in OCI related to technical provisions

The chart below shows the projection for Scenario 1 with maturity limit of the change in OCI (yellow line) with the details on the change in asset revaluation reserve (purple bars) and the change in OCI related to technical liabilities (blue bars). The change in OCI varies in a corridor of -€3m to +€3m in the first thirteen years.

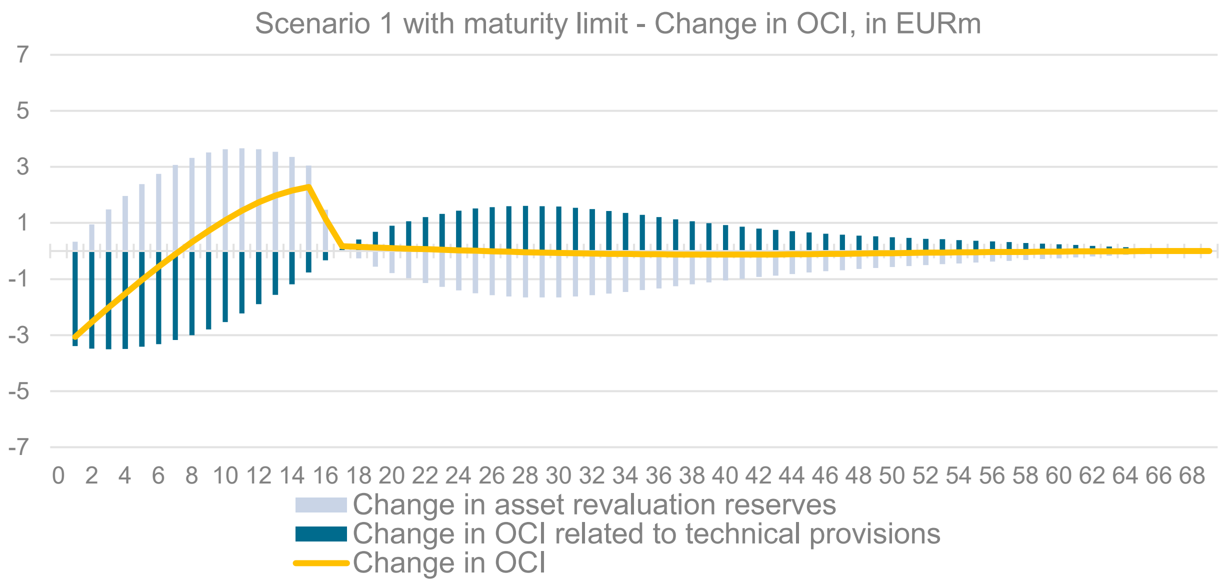


Figure 26: Duration matching strategy – Scenario 1 with maturity limit – Change in OCI

The chart below shows the projection for Scenario 2 with maturity limit of the change in OCI (yellow line) with the details on the change in asset revaluation reserve (purple bars) and the change in OCI related to technical liabilities (blue bars). The change in OCI varies in a corridor of -€5m to +€5m in the first thirteen years.

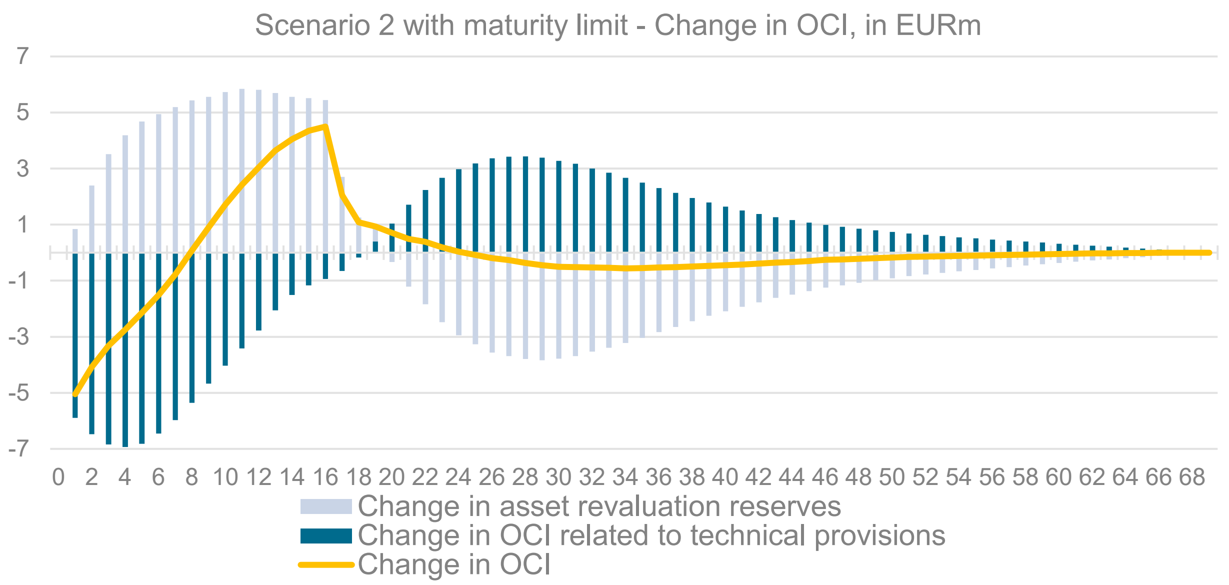


Figure 27: Duration matching strategy – Scenario 2 with maturity limit – Change in OCI

3.4.5. Assessment of accounting volatility related to interest rates

Ratio between the change in OCI and the net income weighted with the sum assured

As a reminder, the analysis of the ratio between the change in OCI and the net income weighted with the sum assured is based on a deviation compared to zero.

For Scenario 1, the average ratio is at 0.6% and the ratio remains in a small corridor with a minimum at -6.3% and a maximum at +5.1%. It results in a small volatility with a standard deviation of only 1.8%.

For Scenario 2, the average ratio is close at 2.3% but it varies in a greater corridor from –79% to +58%. It results in higher volatility with a standard deviation of 16.6%.

In line with the analysis of the change in OCI, the model also considers the assets only invested in cash to test the efficiency of the duration matching strategy.

- For Scenario 1, the average ratio negatively deviates by -16.3% points and the standard deviation of the ratio by +36.6%.
- For Scenario 2, the average ratio negatively deviates by -30.8% points and the standard deviation of the ratio by +55.2% points. The same conclusion as the analysis of the change in OCI can be drawn, even though Scenario 2 has more volatility, it would be even higher without the duration matching strategy.

Overall, the average ratio of the two scenarios are not too different but the non-parallel shift curves have much more volatility on the ratio between change in OCI and the net income (+15% points on the standard deviation).

The table below summarizes the results mentioned above for the average and standard deviation of the ratio between the change in OCI and the net income weighted with the sum assured.

	Ratio between Change in OCI / Net income weighted with sum assured					
	Duration matching		**Cash investment**		***Variations***	
	Average	**Standard Deviation**	**Average**	**Standard Deviation**	***Average***	***Standard Deviation***
Scenario 1	0.6%	1.8%	-15.6%	38.4%	*-16.3% pts*	*+36.6% pts*
Scenario 2	2.3%	16.6%	-28.5%	71.8%	*-30.8% pts*	*+55.2% pts*
Variations	*+1.7% pts*	*+14.8% pts*	*-12.9% pts*	*+33.4% pts*		

Table 6: Duration matching strategy – Scenario 1 versus Scenario 2 without maturity limit – Ratio between Change in OCI / Net income weighted with sum assured

The chart below shows the projection of the ratio between the change in OCI and the net income weighted with the sum assured under the scenarios considered. The ratios for Scenario Base Case (blue line) are exactly equal to zero. The ones for Scenario 1 (pink line) are close to zero, but those for Scenario 2 (yellow line) varies significantly. The change in OCI for Scenario 2 is negative for the first 2 years explaining the negative ratios.

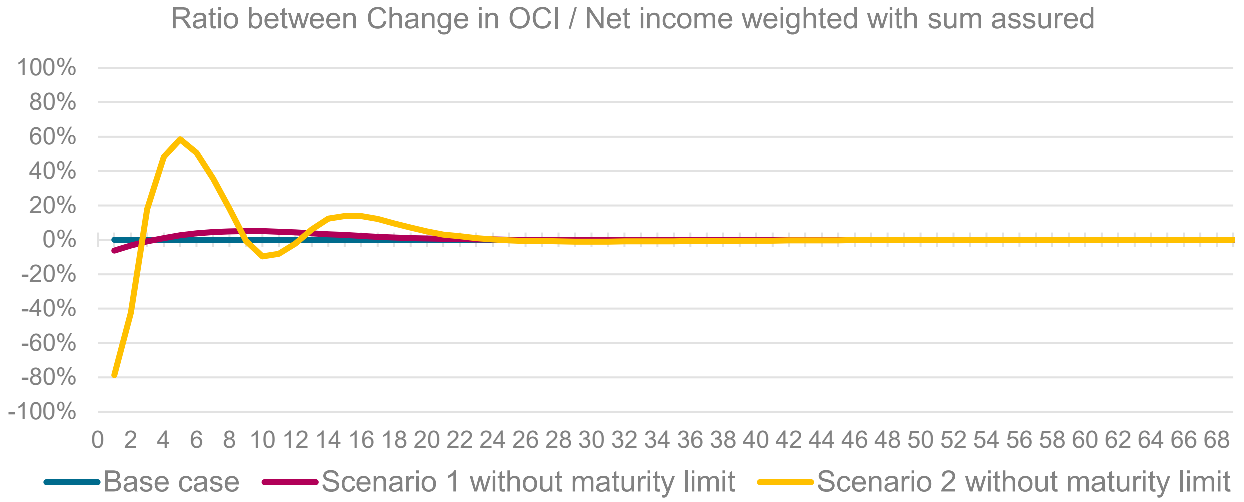


Figure 28: Duration matching strategy – Scenario 1 vs Scenario 2 without maturity limit – Ratio between Change in OCI / Net income weighted with sum assured

The model introduces a maturity limit at 13 years for both Scenario 1 and Scenario 2. As mentioned in the section 3.4.2 Effective duration of the technical liabilities and assets backing them, the duration mismatch was at around 21 and 27 years in average for the first thirteen years respectively for Scenario 1 and Scenario 2 when the maturity is capped at 13 years.

For both Scenario 1 and Scenario 2, the ratios diverge from the scenario without limit during the first thirteen years and then the same pattern as the scenario without maturity limit is followed. Therefore, the analysis looks at both the entire runoff period and the first thirteen years.

Over the entire runoff period:

- For Scenario 1 with maturity limit, the average ratio negatively deviates at -2.6% and the standard deviation at 23.8%, compared to 0.6% and 1.8% respectively without maturity limit.
- For Scenario 2 with maturity limit, the average ratio negatively deviates at -4.2% and the standard deviation at 40.7% compared to 2.3% and 16.6% respectively without maturity limit.

Over the first thirteen years:

- For Scenario 1 with maturity limit, the average ratio negatively deviates at -15.9% and the standard deviation at 49.9%, compared to 2.3% and 3.4% respectively without maturity limit.
- For Scenario 2 with maturity limit, the average ratio negatively deviates at -30.3% and the standard deviation at 83.1%, compared to 7.5% and 35.6% respectively without maturity limit.

For those two scenarios with maturity limit, the net incomes do not change over the projection period, as there are no changes in biometric assumptions and the model is built to achieve a neutral net financial result. Only the change in OCI is affecting the ratios. The maturity limit negatively impacts the average ratios due to negative changes in OCI. Also, for both scenarios, the volatility is significantly impacted in the range of around 22% points to 24% points over the runoff period.

The table below summarizes the ratio between the change in OCI and the net income weighted with the sum assured with and without maturity limit over the full period.

	Full period: Ratio between change in OCI and net income weighted with the sum assured					
	Without maturity limit		**With maturity limit**		***Variations***	
	Average	**Standard Deviation**	**Average**	**Standard Deviation**	***Average***	***Standard Deviation***
Scenario 1	0.6%	1.8%	-2.6%	23.8%	*-3.1% pts*	*+21.9% pts*
Scenario 2	2.3%	16.6%	-4.2%	40.7%	*-6.4% pts*	*+24.2% pts*
Variations	*+1.7% pt*	*+14.8% pts*	*-1.6% pts*	*+16.9% pts*		

Table 7: Duration matching strategy – Scenario 1 versus Scenario 2 with and without maturity limit – Ratio between Change in OCI / Net income weighted with sum assured over the full period

The table below summarizes the ratio between the change in OCI and the net income weighted with the sum assured with and without maturity limit over the first 13 years.

	First 13 years: Ratio between change in OCI and net income weighted with the sum assured					
	Without maturity limit		**With maturity limit**		***Variations***	
	Average	Standard Deviation	Average	Standard Deviation	*Average*	*Standard Deviation*
Scenario 1	2.3%	3.4%	-15.9%	49.9%	*-18.2% pts*	*+46.5% pts*
Scenario 2	7.5%	35.6%	-30.3%	83.1%	*-37.8% pts*	*+47.4% pts*
Variations	*+5.2% pts*	*+32.2% pts*	*-14.4% pts*	*+33.2% pts*		

Table 8: Duration matching strategy – Scenario 1 versus Scenario 2 with and without maturity limit – Ratio between Change in OCI / Net income weighted with sum assured over the first 13 years

The chart below shows the projection of the ratio between the change in OCI and the net income weighted with the sum assured under the scenarios with maturity limit. The ratios for Scenario Base Case (blue line) are exactly equal to zero. The ones for Scenario 1 and Scenario 2 with maturity limit (dash pink line and dash yellow line respectively) diverge significantly from the ones without maturity limit. The negative ratios are explained by the negative change in OCI.

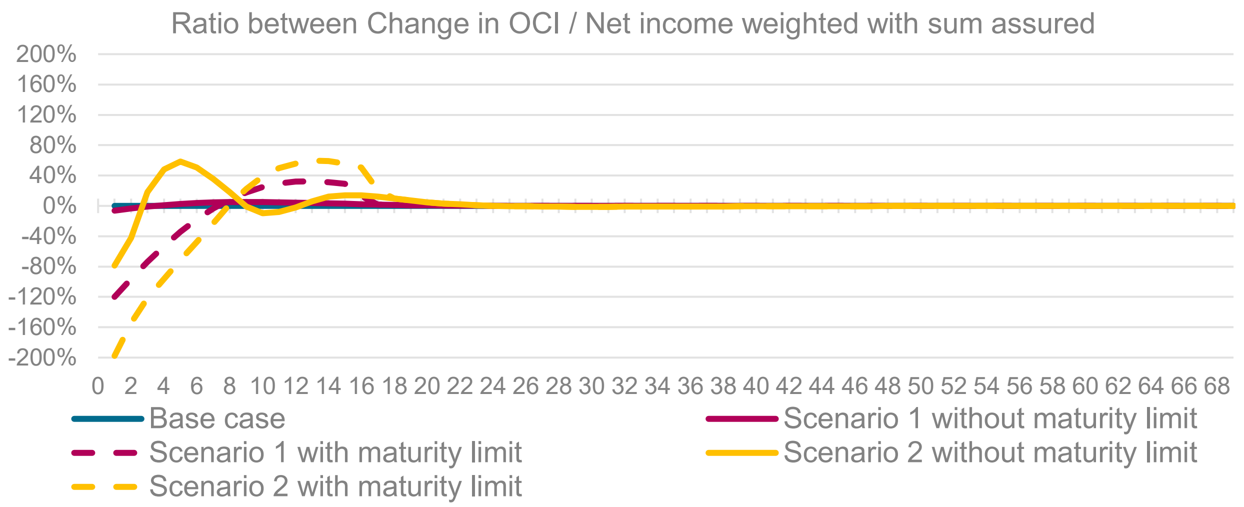


Figure 29: Duration matching strategy – Scenario 1 versus Scenario 2 with and without maturity limit – Ratio between Change in OCI / Net income weighted with sum assured

Return on Equity

As a reminder, the ROE is analyzed by deviation compared to Scenario Base Case. The average ROE over the runoff period was at 5.7% with a standard deviation of 13.8%.

As mentioned before, for the two scenarios considered, there is no difference in the net income generated over the period as there are no changes in biometric assumptions and the model has been built to achieve a neutral net financial result. The shareholders' equity is only comprised of the net income generated and the cumulative changes in OCI. Therefore, the deviation of the ROE is only due to the shareholders' equity related to the change in OCI.

For Scenario 1, the projected ROE over the runoff period is very close to the ones of Scenario Base Case. The average ROE is the same at 5.7% and the standard deviation is slightly higher at 14.6%.

For Scenario 2, the projected ROE over the runoff period is higher than Scenario Base Case. The average ROE is at 12.1%, and the standard deviation is much higher at 57.9%. This is due to the negative change in OCI reducing the shareholders' equity, but the later remains positive. Therefore, the denominator of the ROE equation is reduced, increasing the overall ratio.

The table below summarizes the average and standard deviation of the ROE.

	Return on Equity	
	Average	**Standard Deviation**
Scenario Base Case	5.7%	13.8%
Scenario 1	5.7%	14.6%
***Variation:** Scenario 1 vs Base Case*	*+0.1% pts*	*+0.8% pts*
Scenario 2	12.1%	57.9%
***Variation:** Scenario 2 vs Base Case*	*+6.5% pts*	*+44.2% pts*

Table 9: Duration matching strategy – Scenario 1 versus Scenario 2 – ROE

The model computes the deviation of the ROE in percentage point compared to Scenario Base Case. It helps to assess the volatility on the ROE related to a change in interest rates.

For Scenario 1, the average deviation of the ROE compared to Scenario Base Case stands at +0.1% point. There is almost no deviation of the ROE in average.

However, for Scenario 2, the average deviation of the ROE compared to Scenario Base Case stands at +6.5% points. The deviation of the ROE in average is higher.

The table below summarizes the deviation of the average ROE compared to Scenario Base Case for Scenario 1 and Scenario 2.

Average ROE deviation	**Full period**	**First 13 years**
Scenario 1 without maturity limit	+0.1% pts	+0.7% pts
Scenario 2 without maturity limit	+6.5% pts	+32.9% pts

Table 10: Duration matching strategy – Scenario 1 versus Scenario 2 – ROE deviation compared to Scenario Base Case

The chart below shows the deviation of the ROE for Scenario 1 (pink line) and Scenario 2 (yellow line) compared to Scenario Base Case over the runoff period. The main deviations are in the first years of the portfolio when the duration of the portfolio is still high.

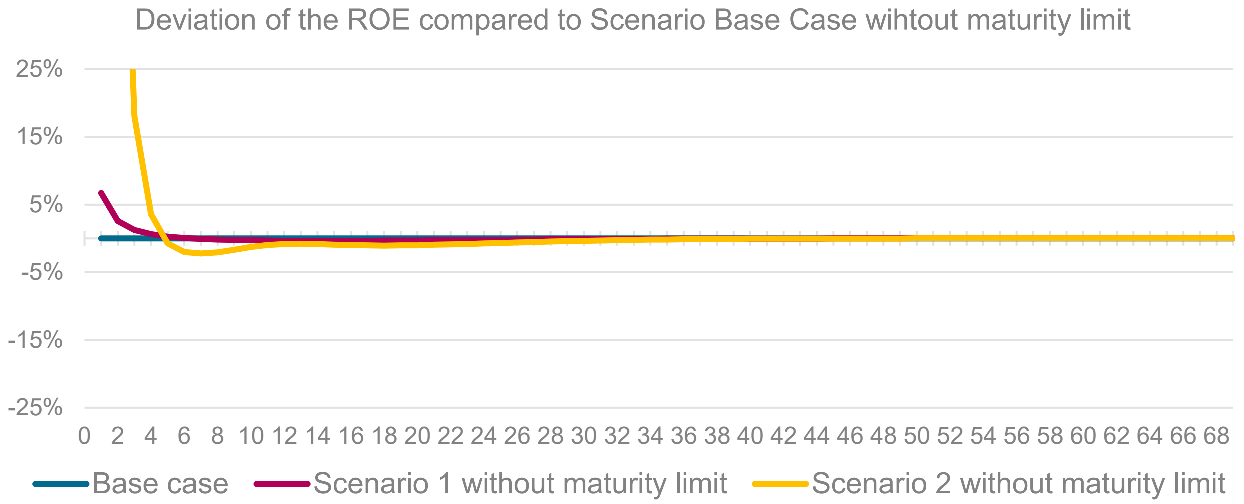


Figure 30: Duration matching strategy – Scenario 1 versus Scenario 2 without maturity limit – ROE deviation compared to Scenario Base Case

For Scenario 2, the first two years of deviation are outliers and to keep the chart readable, they do not appear on the chart. They are however listed in the table below:

ROE deviation vs Base Case Scenario	1	2
Scenario 2 without maturity limit	469.3%	131.6%

Table 11: Duration matching strategy – Scenario 2 – ROE deviation outliers

The model introduces a maturity limit at 13 years for both Scenario 1 and Scenario 2. As mentioned in the section 3.4.2 Effective duration of the technical liabilities and assets backing them, the duration mismatch was at around 21 and 27 years in average for the first thirteen years respectively for Scenario 1 and Scenario 2 when the maturity is capped at 13 years.

For both Scenario 1 and Scenario 2, the ROE diverges from the scenario without limit during the first thirteen years and then it is following a similar pattern as the scenario without maturity limit. Therefore, the analysis looks at both the entire runoff period and the first thirteen years.

Over the entire runoff period:

- For Scenario 1 with maturity limit, the average ratio stands at -15.9% and the standard deviation at 101.7%, compared to 5.7% and 14.8% respectively without maturity limit.
- For Scenario 2 with maturity limit, the average ratio stands at -3.7%% and the standard deviation at 20.4% compared to 12.1% and 57.9% respectively without maturity limit.

Over the first thirteen years:

- For Scenario 1 with maturity limit, the average ratio stands at -84.1% and the standard deviation at 212.6%, compared to 22.4% and 26.3% respectively without maturity limit.

- For Scenario 2 with maturity limit, the average ratio stands at -23.5% and the standard deviation at 39.4% compared to 54.7% and 119.5% respectively without maturity limit.

The table below summarizes the average and standard deviation of the ROE with and without maturity limit over the full period.

	Full period: Return on Equity					
	Without maturity limit		With maturity limit		***Variations***	
	Average	Standard Deviation	Average	Standard Deviation	*Average*	*Standard Deviation*
Base Case Scenario	5.7%	13.8%	5.7%	13.8%	-	-
Scenario 1	5.7%	14.6%	-15.9%	101.7%	*-21.6% pts*	*+87.1% pts*
Scenario 2	12.1%	57.9%	-3.7%	20.4%	*-15.8% pts*	*-37.5% pts*
Variation: *Scenario vs Base Case*	*+0.1% pts*	*+0.8% pts*	*-21.5% pts*	*+88.0% pts*		
	+6.5% pts	*+44.2% pts*	*-9.4% pts*	*+6.6% pts*		

Table 12: Duration matching strategy – Scenario 1 versus Scenario 2 with and without maturity limit – ROE over the full period

The table below summarizes the average and standard deviation of the ROE with and without maturity limit over the first 13 years.

	First 13 years: Return on Equity					
	Without maturity limit		With maturity limit		***Variations***	
	Average	Standard Deviation	Average	Standard Deviation	*Average*	*Standard Deviation*
Base Case Scenario	21.8%	24.5%	21.8%	24.5%	-	-
Scenario 1	22.4%	26.3%	-84.1%	212.6%	*-106.5% pts*	*+186.2% pts*
Scenario 2	54.7%	119.5%	-23.5%	39.4%	*-78.2% pts*	*-80.0% pts*
Variation: *Scenario vs Base Case*	*+0.6% pts*	*+1.8% pts*	*-105.8% pts*	*+188.1% pts*		
	+32.9% pts	*+95.0% pts*	*-45.3% pts*	*+15.0% pts*		

Table 13: Duration matching strategy – Scenario 1 versus Scenario 2 with and without maturity limit – ROE over the first 13 years

The model computes the deviation of the ROE in percentage point compared to Scenario Base Case. It helps to assess the volatility on the ROE related to change in interest rates.

For Scenario 1 with maturity limit, the average deviation of the ROE compared to Scenario Base Case stands at -21.5% points compared to almost no deviation without maturity limit.

For Scenario 2 with maturity limit, the average deviation of the ROE compared to Scenario Base Case stands at -9.4% points.

The table below summarizes the deviation of the average ROE compared to Scenario Base Case for Scenario 1 and Scenario 2.

Average ROE deviation	Full period	First 13 years
Scenario 1 without maturity limit	+0.1% pts	+0.7% pts
Scenario 2 without maturity limit	+6.5% pts	+32.9% pts
Scenario 1 with maturity limit	-21.5% pts	-105.8% pts
Scenario 2 with maturity limit	-9.4% pts	-45.3% pts

Table 14: Duration matching strategy – Scenario 1 versus Scenario 2 with and without maturity limit – ROE deviation compared to Scenario Base Case

3.5. Is IFRS 17 fulfilling its objectives?

As a reminder, IFRS 17 is following the core objectives set by the IFRS about comparability, transparency, and reflecting actual risks. For that purpose, it first moves away from the variety of treatments to a single consistent approach to measuring profitability, allowing for direct comparison between entities reporting under IFRS accounting, then it moves towards a fair value accounting to have a consistent approach with the assets and achieve a fully fair valued balance sheet. Hence, with those two steps, it is expected that IFRS 17 would remove the accounting volatility attributable to IFRS 4.

The objective set forth by the thesis was to analyze to what extent IFRS 17 removes or at least reduces the accounting volatility between the valuation of assets at fair value and technical liabilities with the update of the discount curves.

3.5.1. <u>The conclusions on the case study</u>

The model built for the thesis shows that, with the cash flow matching strategy, there is a residual change in OCI under IFRS 17, corresponding to the theoretical impact of the change in interest rates on the CSM. This is due to the fact that under BBA, the CSM is not sensitive to interest rates movements. Therefore, there is a residual accounting volatility. However, it is only on the CSM and not on the entire technical liabilities as per IFRS 4. It results into much lower volatility related to the change in OCI than under IFRS 4.

The model also considers a duration matching strategy between the assets and the technical liabilities with the assumption of a parallel shift for the projected curves. Under this scenario, the volatility related to the change in OCI is removed. There is no accounting volatility. However, when the model tests a duration matching strategy between the assets and the technical liabilities with a non-parallel shift of the projected curves, residual changes in OCI are observed. The standard deviation is at €633k, which is six times higher than under the scenario of a parallel shift of the projected curves, but it remains low compared to IFRS 4 (with €1.9m of standard deviation). The model has also put the duration matching strategy in perspective with the simulation of an asset strategy where all assets are invested in cash, and it has resulted into a higher impact and volatility on the change in OCI. The standard deviation of the change in OCI jumps to €2.8m. Therefore, under the assumptions taken in the model, IFRS 17 does reduce the accounting volatility, but it is dependent on the asset and liability management strategy chosen.

There are constraints from the financial markets that cannot be avoided, such as the liquidity and the deepness of the market. The thesis has presented the case of a maximum maturity that can be found on the market for financial instruments. It results into higher volatility even under the scenario of the duration matching strategy and the parallel shift of the projected curves. The standard deviation of the change in OCI increases to €817k compared to €111k without maturity limit. This would usually impact portfolio with long-term liabilities, such as long-term care business, or funeral business for example. The volatility describes above has an impact on an insurer’s total comprehensive income. It is used for internal monitoring and strategy, but also externally by the financial markets.

The table below summarizes the standard deviation of the change in OCI mentioned above.

	Standard deviation of Change in OCI		
	Without maturity limit		**With maturity limit**
In EUR	**Duration matching**	**Cash investment**	**Duration matching**
IFRS 4	1,863,433		
Scenario 1	111,363	1,532,185	816,609
Scenario 2	633,272	2,843,593	1,557,508

Table 15: Standard deviation of Change in OCI

Not only the move from IFRS 4 to IFRS 17, but also the change in OCI, do not have an impact on the overall profitability of a portfolio.
Indeed, all else being equal between IFRS 4 and IFRS 17, the change is related to the pattern of the emergence of the profits, but it does not change the profitability of a business. In other words, the cumulative net income under IFRS 4 and IFRS 17 over the runoff period are the same. Under IFRS 4, the main part of the profits is recognized at inception, while under IFRS 17, the pattern of the profit emergence would be smoother through the runoff period, as services are provided.
The change in OCI also does not change the overall profitability of a portfolio. The unrealized gains or losses are related to accounting and are not an actual gain or loss in profits. When realizing a gain, it has a positive impact on the income statement, but it will deteriorate future investment return. It would be more accurate to describe it as an anticipation of future profits.

Therefore, the impact that is analyzed is only on the volatility of the total comprehensive income due to a change in interest rates. In the model, the volatility of the total comprehensive income is assessed through the ratio between the change in OCI and the net income weighted with the sum assured. Under the scenario with a duration matching strategy between assets and liabilities, and with a non-parallel shift of the projected curves, the average ratio is close to the scenario without interest rates movements, but the standard deviation is higher at 16.6% (to be compared to 0%). When comparing to IFRS 4, the volatility of the ratio is much higher with a standard deviation jumping to 573.3%.

As a conclusion, under the assumptions taken in the model for the thesis, IFRS 17 does reduce the accounting volatility, but it is dependent on the asset and liability management strategy chosen, and on the types of movements on the interest rates. There is residual volatility that can be observed under IFRS 17 with both approaches contemplated in the thesis, cash flows matching strategy and duration matching strategy. However, the residual volatility remains much lower than investing all assets into cash for example, and as well much lower than under IFRS 4.

3.5.2. The limits of the case study

It is understood that those conclusions are to be considered under the assumptions taken in the model for the thesis. Some of the approaches chosen for the thesis are simplified approaches to answer the objective set forth by the thesis. The section provides the limitations of the case study.

In terms of yield curves chosen for the technical liabilities and the assets backing them, the same yield curves have been assumed. It would be the case in reality, if it is possible to find an index on the financial markets, which replicates the same characteristics as the technical liabilities. However, indexes from financial markets would usually need to be adjusted for their liquidity compared to the illiquidity of technical liabilities. Using different yield curve would have an impact on the change in OCI.
A way to assess that point could be to consider for the investment yield an index, such as the ICE BofA Euro Corporate Index for the invested assets and the EIOPA with Volatility Adjustment for the technical liabilities discount curve. The corporate bonds index would also address the issue related to the maximum maturity for the invested assets as the longest subset index is the ICE BofA 10+ Year Euro Corporate Index, and it has an average maturity of 13 years.

The thesis shows that the reduction of the accounting volatility is dependent on the asset and liability management strategy chosen and on the types of movements of the interest rates. The thesis is only contemplating, the cash flow matching strategy and the duration matching strategy. For the duration matching, the duration chosen is the effective duration. Some other types could be contemplated, such as the key rate duration to remove the accounting volatility for the scenario with non-parallel shift projection for the curves. The key rate duration can be seen as an improvement of the effective duration as it provides the expected changes in price when the yield curve shifts in a non-parallel manner.

On the assets invested backing the technical liabilities, the thesis assumes that all of them are invested in fixed income. Even though it represents the main asset class used by the insurance companies in Europe, there are other types of assets that can be considered, such as equity or loans for example. Under IFRS 9, the change in fair value of those types of assets would not necessarily flow through the OCI but could flow through the income statement. Assuming that the OCI option is chosen for the change in fair value of the technical liabilities under IFRS 17, the inconsistency of the accounting treatment according to the asset types may create accounting volatility.

The three limitations mentioned above, if being addressed, would have fleshed out the results with more scenarios. However, the two following limitations may have more implication when looking at the sensitivity to interest rates movements for an insurer.

The particularity of the model built for the thesis is that it is contemplating a closed block of business, i.e., the financial statements analyzed are only for one group of contracts. However, when the assessment is made by external stakeholders, it would not be able to achieve the same analysis as it would be on a whole balance sheet including all components broader than just one group of contracts. The thesis has analyzed the change in OCI related to the technical liabilities directly with the change in asset revaluation reserve. However, these are not covering the same scope when looking at a balance sheet as a whole. The assets are not only backing the technical liabilities, but they are also backing some other parts of the balance sheet, such as the shareholders' equity for example. Those assets are subject to a change in value, the impact would also flow in the asset revaluation reserve (if they fulfill IFRS 9 criteria). Another difference between the asset revaluation reserve and the OCI related to the change in value of the technical liabilities is that the asset revaluation reserve incorporates more than just interest rates movements, such as the credit spread movements, should the spread tighten or widen for example. It is not impossible that the discount curve under IFRS 17 would also incorporate the spread movements if the characteristics of the technical liabilities as well include sensitivity to credit spread movements. But the approach described in the thesis with the EIOPA curve would not include it. Therefore, looking at the balance sheet as a whole would not provide a direct assessment of the asset and liability management for the technical cash flows of a company.

Finally, the thesis focuses on the interest rates movements under IFRS 17 and has provided sensitivities of those movements. The thesis has kept the biometric assumptions unchanged compared to inception of the group of contracts. However, another main change with IFRS 17 is the change in biometric assumptions at each reporting date. The assessment of the volatility related to the update of the biometric assumptions could be put in perspective compared to the update of the discount curve. That being said, it would involve a different approach and require a model with sensitivities to biometric assumptions, which may be addressed by another thesis.

It was not the intention of the thesis to be exhaustive and cover all the aspects mentioned above but the objective was to provide a good understanding of the sensitivity to interest rates of the income statement and balance sheet under IFRS 17.

3.5.3. The implications of understanding the sensitivity to interest rates

On the financial markets, the insurance industry is seen as a sector with low growth but with relatively good return. It is known historically to pay stable to increased dividend. This aspect of paying back cash is particularly important for the financial markets. Therefore, even though the operational result achieves the objective set by the insurer, the financial markets would still look at the bottom-line of the total comprehensive income. The insurance sector remains a complex one due to its different specificities, such as its unique business model with the inverted production cycle, or the importance of a robust asset and liability management strategy.

The change to IFRS 17 creates apprehension from analysts of the financial markets, which can translate into higher cost of capital to invest in insurance sector. The main apprehensions from financial markets towards IFRS 17 are the analysts losing their bearings without an IFRS 17 historical database, the limited comparability due to optionality offered by IFRS 17 to some key concepts, and the risk of having higher volatility in results.

On the volatility, as the one related to interest rates addressed in the thesis, it requires thorough and in-depth analysis to have a good understanding and assessment of the volatility of the results. Despite some simplified assumptions taken in the model, the thesis shows that even though the volatility related to accounting rules is not totally removed, it is reduced compared to IFRS 4 by achieving lower volatility on the change in OCI, and consequently on the total comprehensive income and on the ROE. This should have a positive effect on the analysis made on an insurance company once IFRS 17 is in place. Moreover, the thesis shows that more than ever, the asset and liability management strategy is key in the assessment of the sensitivity to interest rates movements. Hence, it should be a focus for the assessment of an insurer.

It is important to have in mind that the change in interest rates is not an element that an insurer can predict, it is something that the insurer undergoes. Nonetheless, the impact of the change in interest rates on key metrics is something that the insurer should be able to understand and explain clearly and transparently. The importance of understanding the sensitivity to interest rates on an insurer’s balance sheet and income statement can be seen through an insurer performing an analysis of changes from a reporting date to another to understand the sources of the variations. Those changes can come from the business generation, regulatory changes, economic and market variances, or capital management. The impact of a change in interest rates would be part of the economic and market variances. When an insurer is capable to understand and explain those changes, it shows that the insurer knows its exposure to the business, the regulation, and the market. This demonstration gives comfort to the financial markets that the insurer masters its business and risks, and understands the market variances that it undergoes.

Conclusion

IFRS 17 is meant to address the critics that were made to IFRS 4, namely the comparability and the accounting volatility, to fulfill the objectives set by the IFRS: comparability, transparency, and reflecting actual risks. For that purpose, IFRS 17 first moves away from the variety of treatments to a single consistent approach to measuring profitability, allowing for direct comparison between entities reporting under IFRS accounting. Then it moves towards a fair value accounting to have a consistent approach with the assets and achieve a fully fair valued balance sheet.

The objective of the thesis was to analyze to what extent IFRS 17 removes or at least reduces the accounting volatility between the valuation of assets at fair value and technical liabilities with the update of the discount curves. Wherefore, the analysis focuses on the sensitivity to interest rates movements on the financial statements under IFRS 17 through a case study based on a long-term care portfolio.

The long-term care portfolio has been chosen for its long-term duration. The analysis of the sensitivity to interest rates movements includes an appraisal under IFRS 4 to better appreciate the change to IFRS 17. It then focuses on IFRS 17 under two asset and liability management strategies, a cash flow matching, and a duration matching, with two different interest rates movements, a parallel shift, and a non-parallel shift.

Under the assumptions taken in the model for the thesis, IFRS 17 does reduce the accounting volatility, but it is dependent on the asset and liability management strategy chosen. The cash flow matching strategy highlights the residual accounting volatility due to the CSM not being sensitive to a change in interest rates. The duration matching strategy with a parallel shift movement of the yield curves could remove almost the entire accounting volatility. However, a non-parallel shift movement of the interest rates has residual volatility. Nonetheless, any residual volatility observed was still lower than the accounting volatility under IFRS 4. Moreover, the strategies contemplated may not fully remove the volatility, it was still much lower than the scenario of investing all assets in cash for example. Therefore, an appropriate asset and liability management strategy is key to maintain a low volatility.
However, there are irreducible constraints from the financial markets, such as the liquidity and the deepness of the market. The thesis has considered a limit in the maturity that can be found on the market for the financial instruments. This constraint increases the volatility, even for the scenario with the duration matching strategy with the parallel shift, which was removing the accounting volatility. This would usually impact portfolio with long-term liability duration.

It is understood that those conclusions are to be considered under the assumptions and proxy taken in the model for the thesis. Some of the approaches chosen for the thesis are simplified approaches to answer the objective set forth by the thesis. It was not the intention of the thesis to be exhaustive and cover all the aspects, but the objective was to provide a good understanding of the sensitivity to interest rates on the income statement and balance sheet under IFRS 17.
Among those simplifications, the thesis has used the same yield curve for both the discounting of the technical liabilities and the investment return of the assets backing them, it has contemplated only two asset and liability management strategies, it has only used the effective duration in the duration matching strategy, and it has only considered fixed income in the invested assets. Addressing those limits would have fleshed out the results with more scenarios. But two more limitations are worth being described more in-depth.
The first one is that the thesis is contemplating a closed block of business, i.e., the financial statements analyzed are only for one group of contracts. However, when an external stakeholder attempts the same analysis, it will not be able to achieve it. Indeed, in the thesis the change in OCI related to the technical liabilities has been directly compared to the asset revaluation reserve. But the latter is backing a broader scope than just the technical liabilities and is sensitive to credit spread movements. Whereas the OCI related to technical liabilities would only capture the change in the discount curve. Looking at the balance sheet as a whole would not provide a direct assessment of the asset and liability management for technical cash flows.

The second limitation is that the thesis does not put in perspective the volatility related to interest rates movements with the volatility that may arise from the change in biometric assumptions. Indeed, one of the main changes to IFRS 17 is the change in biometric assumptions at each reporting date. It would permit to assess the materiality of those two components. However, it would require another model including sensitivity to biometric assumptions, and another thesis.

As the analysis of the volatility can also be assessed by the financial markets, it is important to understand how it is going to be perceived. On the financial markets, insurance industry is seen as a sector with low growth but with relatively good return through dividend payments.
The insurance sector is already considered as a complex one to analyze, the change to IFRS 17 is creating apprehension from analysts of the financial markets, which can translate into higher cost of capital to invest in the insurance sector. The apprehensions mentioned on the market are related to the impossibility to analyze historical data, the limited comparability due to optionality offered by IFRS 17 to some key concepts, and the risk of having higher volatility.

It is understandable that the lack of IFRS 17 historical data can constitute a loss of reference for an analysis. It would require proxy to bridge the gap between IFRS 4 and IFRS 17. However, in terms of comparability, the standard does offer some options, but the companies are still under one consistent standard, when IFRS 4 allows local regimes treatments. Also, the volatility requires a good understanding of its source and materiality to be accurately assessed as a risk or not. The volatility related to a change in biometric assumptions is not analyzed in the thesis, but the one related to a change in interest rates is. The thesis has shown that to some extents IFRS 17 is going in the right direction.

Moving towards the implementation of IFRS 17, it will require a joint effort between the insurance industry's actors and the financial markets analyzing them.
It will be obviously important for the insurance companies to fully understand the new standard and to be able to explain the emergence and or the volatility on the profits among other things. As important, the way insurance companies are going to disclose and communicate their results to the market under IFRS 17 will be key to remove the apprehensions of the market. More than ever, the clarity and the transparency will be at the center of external disclosure. On the financial markets, it will be crucial for the analysts to have a perfect understanding of the new standard, and not only rely on the disclosure and the communication of the insurance companies.

As the overall profitability of a portfolio is not changing because of accounting rules, one of the ways that can be explored moving forward with IFRS 17 is for example a communication focused on the free-cash movements, which remains a constant metric between the two standards. This would be beneficial with regards to the dividend distribution assessment, which is key for the sector. At last, the idea is to find constant metrics, which not only help to fulfill the business objectives, to comply with the regulation, but also to break free from accounting volatility.

List of abbreviations

Abbreviation	Explanation
AC	Amortized Cost
AGGIR	Autonomie Gérontologie Groupes Iso-Ressources
APA	Allocation Personnalisée d'Autonomie
AVQ	Actes de la Vie Quotidienne
BBA	Building Block Approach
BE	Best Estimates
bps	basis points
CSM	Contractual Service Margin
DAC	Deferred Acquisition Costs
EPS	Earnings Per Share
FVOCI	Fair Value through OCI
FVPL	Fair Value recognized in P&L
GAAP	Generally Accepted Accounting Principles
IASB	International Accounting Standards Board
IASC	International Accounting Standards Committee
i.e.,	id est
IFRS	International Financial Reporting Standards
k	thousand
KPI	Key Performance Indicators
LIC	Liability for Incurred Claims
LRC	Liability for Remaining Coverage
m	million
OCI	Other Comprehensive Income
P&L	Profits and Losses
PAA	Premium Allocation Approach
Risk Adjustment	Risk Adjustment for non-financial risk
ROE	Return on Equity
TME	Taux moyen d'emprunt d'Etat
UPR	Unearned Premium Reserves
VBA	Visual Basis for Application
VFA	Variable Fee Approach

Bibliography

AICPA, A. I. (n.d.). Retrieved from https://www.ifrs.com/ifrs_faqs.html

dictionary, O. E. (n.d.).

EIOPA. (2020). *EIOPA Insurance Statistics* . Retrieved from https://app.powerbi.com/view?r=eyJrIjoiM2M3MWM4NjMtMGExMC00YjkzLTkwNTYtOTZhMjg1N2MwYjFmIiwidCI6IjgwZWU5MTljLTRjNmMtNDI3Ny04ZTJmLTQyZjg2NWExZmQxNCIsImMiOjl9

Hull, J. C. (2018). *Options, Futures, and Other Derivatives.*

IASB. (2004). *IFRS 4 Insurance Contracts - Appendix A.*

IASB. (2004). *IFRS 4 Insurance Contracts - Article 15.*

IASB. (2004). *IFRS 4 Insurance Contracts - Article 25.*

IASB. (2004). *IFRS 4 Insurance Contracts - Article 30.*

IASB. (2011). *IFRS 13 Fair Value Measurement - Appendix A.*

IASB. (2020). *IFRS 17 Insurance Contracts - Appendix A.*

IASB. (2020). *IFRS 17 Insurance Contracts - Article 17.36.*

IASB. (2020). *IFRS 17 Insurance Contracts - Article B78.*

IASB. (2020). *IFRS 17 Insurance Contracts - Article B82.*

IASB. (n.d.). *IFRS 17 Insurance Contracts - Article B44.* 2020.

IASB. (n.d.). *IFRS: who we are - about us*. Retrieved from IFRS: https://www.ifrs.org/about-us/who-we-are/

IASB. (n.d.). *IFRS: who we are - our mission statement*. Retrieved from IFRS: https://www.ifrs.org/about-us/who-we-are/

IFRS-Foundation. (n.d.). *View our new interactive map to discover more about the use of IFRS Standards around the world*. Retrieved from Twitter: https://twitter.com/ifrsfoundation/status/875724917169324032?lang=fr

Jessop, N. (2019). *Permitted approaches for constructing IFRS 17 Discount Rates.* Moody's.

KPMG. (2020). *First Impressions 2020 Edition.*

Le Gal, A. (2020). *Analyse du risque dépendance en France: Calibration de lois biométriques et influence des caractéristiques des contrats sur la sinistralité.*

Luzon, A. (2019). *Mise à jour de la loi d'incidence et de maintien d'un contrat de dépendance et Impact sur le provisionnement.*

Morrison, S. (2018). *Profit emergence under IFRS 17.* Moody's.

Murray, A. (2005). *Mind the GAAP Fitch's view on Insurance IFRS.*

Reintano, R. R. (1991). *Nonparallel Yield Curve and Duration Leverage.*

SPAC. (n.d.). *TME : Historique du TME depuis 1996*. Retrieved from https://www.spac-actuaires.fr/lexique/tme-historique-du-tme-depuis-1996

Thérond, P. (2009). *Comptabilisation IFRS des engagements d'assurance.*

Appendices

Appendix 1: Definitions from IFRS standards

IFRS 13 Fair Value Measurement – Appendix A: "Fair value is the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date".

IFRS 4 Insurance Contracts – Appendix A: "A contract under which one party (the insurer) accepts significant insurance risk from another party (the policyholder) by agreeing to compensate the policyholder if a specified uncertain future event (the insured event) adversely affects the policyholder".

IFRS 17 Insurance Contracts – Appendix A: "An insurance contract for which, at inception: (a) the contractual terms specify that the policyholder participates in a share of a clearly identified pool of underlying items; (b) the entity expects to pay to the policyholder an amount equal to a substantial share of the fair value returns on the underlying items; and (c) the entity expects a substantial proportion of any change in the amounts to be paid to the policyholder to vary with the change in fair value of the underlying items."

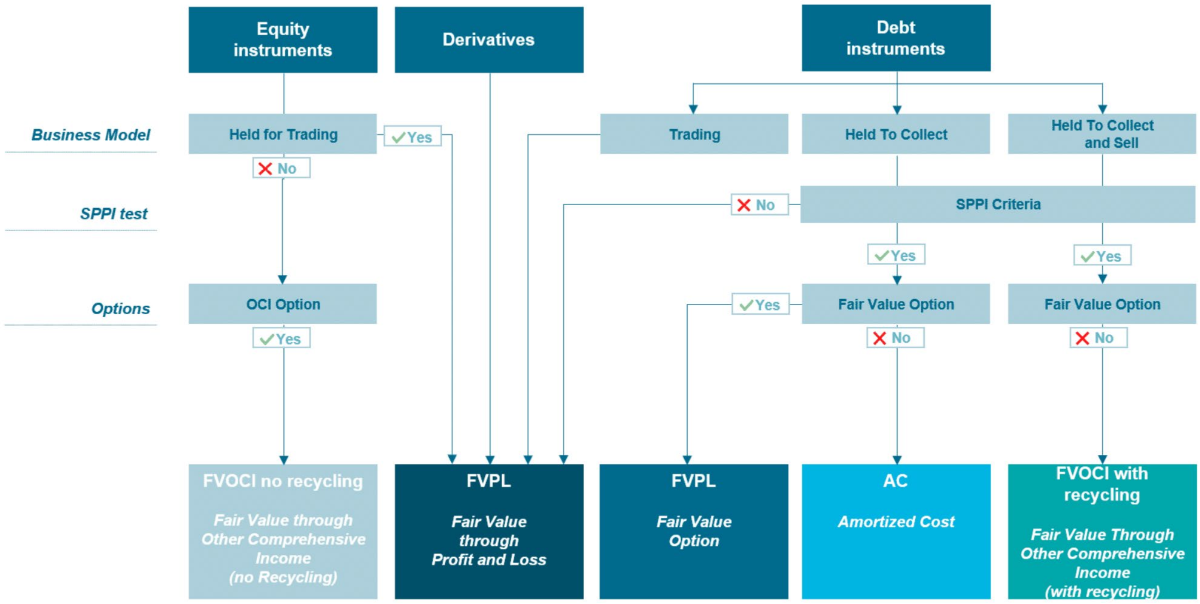
Appendix 2: Map of the countries using the IFRS Standards

The official website of the IFRS mentions that 166 jurisdictions using the IFRS Standards. The map below from the IFRS Foundation official twitter account shows the countries applying the IFRS Standard as of 2017.

Source: IFRS Foundation official twitter account

Figure 31: Map of the countries using the IFRS Standards

Appendix 3: Decision tree for IFRS 9 financial assets classification



Source: SCOR Internal training

Figure 32: Decision tree for IFRS 9 financial assets classification

Appendix 4: EIOPA discount curve with Volatility Adjustment – spot and forward rates

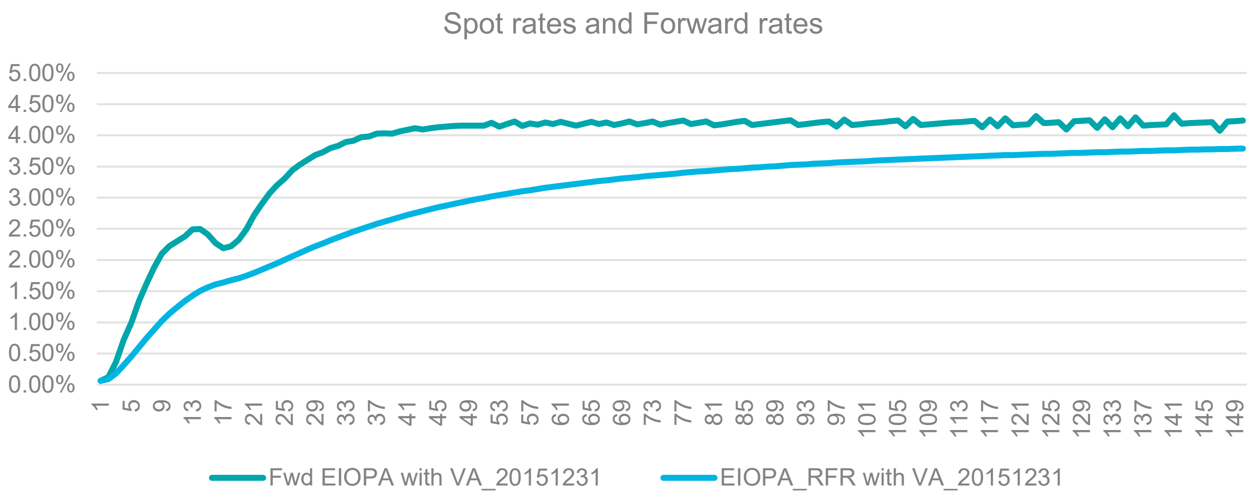


Figure 33: EIOPA discount curve with Volatility Adjustment as of 31/12/2015 – spot and forward rates

Appendix 5: Nonparallel Yield Curve Shifts and Duration Leverage

The paper from Robert R. Reitano describes the sensitivity to non-parallel shifts on an asset portfolio. It addresses the variation in price when the yield curve does not move in parallel. The paper introduces the notions of partial duration to define an 'equivalent parallel shift' for any yield curve shift. It says that the overall duration approximation is equal to the sum of the partial duration approximation.

Extract from the paper 'Nonparallel Yield Curve Shifts and Duration Leverage' by Robert R. Reitano:

"In general, given any yield curve shift $\overline{\Delta_{\iota}}$, one can define an "equivalent parallel shift" Δ_{iE}. This is defined so that the traditional duration approximation" D "with Δ_{iE} equals to the partial duration approximation [...] with the point by point yield shift" is equal to "$P' \approx P \times (1 - \sum_i D_i \times \Delta_i)$" where P' is the approximated price, P is the original price, D_i is the modified duration for the point i, and Δ_i is the change in interest rates for the point i. "To do this, all that is required is that the duration is nonzero". "In these cases, Δ_{iE} is just the weighted average of the individual shifts $\Delta_{iE} = \sum_i a_i \times \Delta_i$, where $a_i = \frac{D_i}{D}$."
(Reintano, 1991)

Appendix 6: ICE BofA 10+ Year Euro Corporate Index

Extract from Bloomberg of the factsheet for ICE BofA 10+ Year Euro Corporate Index:

ICE BofA 10+ Year Euro Corporate Index (ER09) - distribution characteristics as of 11.15.2021 ICE Index Platform

Index distribution by Rating	# Bonds	FullVal	%Full Val	Eff Dur	Contr EffDur	Eff Yld	OAS	TRR%MTD	ExRtn%MTD
AAA	2	3,047.619	0.84602	10.49	0.09	0.40	65	1.122	-0.434
AA	43	39,476.017	10.95855	15.28	1.67	0.82	97	1.327	-0.303
A	168	147,836.346	41.03938	12.83	5.27	0.89	110	1.112	-0.435
BBB	184	169,870.472	47.15606	12.07	5.69	1.16	137	1.136	-0.372
Grand Total	397	360,230.453	100.00000	12.72	12.72	1.01	121	1.147	-0.391

Source: Bloomberg