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Revision of the Mortgage Payment Protection Insurance respecting Solvency II

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Colophon

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Management summary

This thesis describes the process of revising the Mortgage Payment Protection Insurance (MPPI) respecting Solvency II. A revision is needed in order to fulfil the Solvency II regulations introduced by the European Union. The regulations will take effect on 1 January 2016.

The Solvency II regulations for the insurance industry are introduced to establish an individual risk profile for the insurer. This results in a more transparent risk profile which is comparable with the European insurance industry. The regulations apply to all the insurance companies throughout Europe. The regulations consist of three pillars. The first pillar establishes minimum capital requirements, the second pillar establishes the supervisory review and the last pillar states the market discipline. The first pillar is the reason why revision is necessary. In order to define a risk profile of an insurance product, the insurance has to be established as best estimate. As result, the premium, provisions and risk capital determination have to be revised.

In the literature the MPPI is categorized as a PPI, Payment Protection Insurance. This insurance provides a coverage for a customer in case the customer becomes unable to fulfil its (monthly) payments. Accidents, sickness and unemployment are generally protected with a PPI. This research focuses on the MPPI of Interpolis, a brand of Achmea. The MPPI of Achmea offers unemployment and disability protection.
Normally, insurances are categorized as life or non-life insurances. In a MPPI both aspects are present: life aspects for the disability part and non-life aspects for the unemployment part. Focusing on premium establishment for insurances with both aspects, almost no literature about this combination is available. As a result, the KAZO-model as defined by Gregorius (1992) is used as an underlying model. The model is developed and widely used for disability insurances in the Netherlands. It is a Markov-type model and consists of eight different states. A person can be; active, a person is not disabled; dead or inactive; a disabled person. An inactive person can recover during the first five years of being disabled, afterwards the recovery probability is assumed to be zero in the KAZO model. Originally the KAZO-model is designed for disability insurance, hence the model is applicable for the disability part of the insurance. To calculate the disability part of the premium, the mortality, morbidity and recovery probabilities are needed to derive the retention rates, which give more insight into the duration and eventually into the disability premium. Payouts with respect to the unemployment part are mainly short term, with a maximum of 1 year. This is in contrast with the disability part. Therefore the KAZO-model needs to be adjusted. In order to keep the model simple, the unemployment probability times the average duration for a specific age category corrected with the mortality rate for a given age, are used to calculate the unemployment part of the premium. By the scope of this research the underlying model remains the same; further research can clarify if adjustments are needed.

To adjust the MPPI into the best estimate, parameters and foundations are adjusted, added and removed. For the disability part, the internal registered claims are evaluated and the realized rates are established. These rates, are compared with the current rates and with the new rates, retrieved from the Verbondsmodel 2006, as defined by het Verbond van Verzekeraars.
The mortality probabilities are low. Therefore it is not possible to derive internal rates. As a result, the GBM/GBV 1995-2000, defined by the Koninklijk Actuarieel Genootschap, is used. The realized recovery rates and the current and Verbondsmodel rates differ so much that correction factors are needed. The morbidity rates of the Verbondsmodel are useful after the second year of being disabled. These rates are adjusted in order to give the rates after being disabled for one year. To avoid double counting, the rates are correct, at a specific time, a person can be unemployed or disabled but not both. Afterwards, the new rates are compared with the realized rates. It can be concluded that these rates correspond.
Besides external data for the mortality, external data is also used for the morbidity and the recovery probabilities as internal dataset was too small. As a result, the morbidity probabilities are implemented before implementing the recovery probabilities. Additionally, age-category dependent correction factors are added.

For the unemployment part, also internal probabilities and durations are compared with external datasets. Again by the size of the dataset, the external dataset, data of the Centraal Bureau voor de Statistiek (CBS), with some correction factors is used. After comparison, some contradictions in the dataset where visible. To correct this, age dependent correction factors are implemented. These correction factors are determined with the least squares method.
Data of the Uitvoeringsinstituut Werknemersverzekeringen (UWV) is used for the unemployment durations. To correct for the work history, this is taken into account in the UWV dataset again some corrections are implemented. As a result, a net premium can be derived.
To retrieve a gross premium, other parameters as costs, solvability charge, etc., are also adjusted to attain the best estimate. The premium can drop to a maximum of 55%, depending on the choices: unemployment protection, insured amount, insured duration, age and interest rate. The premium has become more age dependent, whereby younger age-categories benefit more that older age-categories. Due to the new lower recovery rates the longer durations benefit more than short ones. Looking at the policies with an unemployment protection, a larger decline is visible. Last, the interest rate has a noticeable effect on the premium determination. Further research is needed to retrieve a new interest rate. With a rough estimation the difference in premium revenue is calculated, as a result the revenues will decrease with 21.4% when implementing the new proposed premium.

Subsequently, the disability provisions have to be revised as well. Currently these provisions are determined as maximum. When someone becomes disabled, the monthly insured amount for the entire duration is reserved. As stated earlier in this research the recovery probabilities are higher than zero. Therefore, reserving as maximum is not the best estimate. Using the earlier derived disability rates, the disability provisions for the current product can decrease with 23% in the first year. The drop depends on the insured duration and the number of years being disabled. For longer durations and newly disabled, the provisions will decrease more drastically, which is caused by the recovery rates.

In line with the Solvency II regulations, the insurance product has to be established as the best estimate. This applies for the premium as well as for the provisions. As a result, the risk capital can be determined. Determining the risk capital without having the best estimate insurance, is not relevant because the risk formulas as given in the regulation assume best estimates.
Reserve risk is defined as the risk that the provisions for the ongoing claims are sufficient. Premium risk is defined as the risk of having insufficient premium income to pay for new claims. For the MPPI, these two risks are the most important ones. Within the regulations, four methods are handed to define the risk capital. Caused by the characteristic of the MPPI, the standard formula and the internal model are applicable. Currently, the standard non-life method is used for the risk determination. These standard formulas are derived with data from all over Europe. However, the underlying definitions are not discussed and no season effects are taken into account, resulting a general formula is derived. This formula has to be applicable for all the insurance companies in Europe. In order to determine the risk a specific product is facing the internal model, established by the organization itself, can be used. Focusing on the two most important risks for the MPPI, it can be concluded that for reserve risk, it might be possible to develop an internal model. However, first the dataset has to be tested, further research is needed to deliver a distinctive answer. For premium risk, it is currently not possible to develop an internal model. The dataset is too small and has a too short history, to give a good estimation. Nevertheless, even if there is no internal model, the effect of the revision is also visible when using the standard model. The reserve risk capital can decrease with 14,2% and the premium risk capital can decrease with 21,4%.

Resulting, the MPPI has to be revised to make the MPPI more risk-based, as required according to Solvency II regulations.

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Looking back, the past seven months have been valuable experience, working in a new and interesting environment. In addition I learned one other important thing, that is that nobody is here forever. You have to live for the moment, each and every day!

I hope you will enjoy reading it.

Kim Huijberts
Eindhoven, 2014

Content

List of figures

List of Tables

Chapter 1: Introduction

1.1 Background

Where banks before Basel Regulations only defined a minimum ratio for capital to assets and maximum ratio for assets to capital currently banks know this is not enough. Due to the recent credit crisis, banks are even more aware of the risks they are facing. And not only banks are aware of the risks, all the financial institutions know that risk management is needed. Since 1988, credit risk for banks is regulated internationally with the Basel Regulations issued by Basel Committee. After Basel I, also Basel II and Basel III are introduced, more and more risks have to be taken into account in order to reserve enough capital (Hull, 2010). According to Ashby (2011); *"The recent banking crisis was caused by: human/cultural weaknesses at the industry-wide, communication weaknesses within some financial institutions and in the weaknesses in the prudential regime for banks."*

Currently, looking towards the (global) regulation of insurance companies it appears to be at a crossroad (Ashby, 2011). Different countries are reforming their regimes such as Internal Capital Assessment Standards (ICAS), the Swiss Solvency Test (SST) and the European Union with Solvency II. As mentioned by Doff (2008); "*The Solvency II regulation is the most important because (1) it is a concrete legal framework rather than principles; (2) it will apply to a large and important insurance market."* Where the banking industry presents a risk profile of a particular bank the Solvency regulations are mostly based on technical provisions (Benink, 2005). Solvency II attempts to revise this solvency requirement; to update a uniform regulatory framework for insurance supervision in Europe (Doff, 2008).

The solvency regime was introduced in the early 1970s since then more elaborate risk management systems are developed individually by different countries. To cooperate within Europe the European commission came with a two-step approach, Solvency I & II. Where Solvency I was realizing a revisited and up to date solvent regime without changing the structure, Solvency II has to be fundamentally reformed in order to realize a decent solvency regime (Doff, 2008; Hull, 2010; Eling, Schmeiser & Schmitt, 2007). To establish required capital, in the past only underwriting risks were taken into account. With the introduction of Solvency II, a unique risk profile can be quantified including operational risk, market risk, counterparty risk, insurance risk and business risk (Moody's Analytics, 2011). The aim of Solvency II; "*Establish an individual risk profile for the insurer, bring assets and liabilities into fair value basis, harmonize standards across Europe and set higher capital requirements to permit timely intervention."* (PUI, 2014). The Implementation of the Solvency II regulations is more complex than expected. Therefore the implementation of Solvency II, which was planned for 1 January 2014, is postponed until 1 January 2016. Solvency II provides two methods to calculate risk capital; a standardized approach and the internal approach (Achmea D, 2014 and Achmea, 2013). Achmea, market leader in the Dutch Insurance Industry has to implement the new Solvency II regulation and hence the set of capital requirements into their holding.

1.2 Achmea

With the statement: "To carry the damage of others when they are facing risks" Achmea, a co-operative, was started in 1811, in Achlum in the Netherlands. To protect a farmer from going bankrupt when his farm burns down, an insurance organization is launched. Where Achmea started as Waarborgmaatschappij Achlum, during the last two decades the Achmea Society (Vereniging Achmea) is founded with the merger of a number of mutual insurance companies and health insurance funds. Currently Achmea is operating in the Netherlands as well as in Australia, Bulgaria, Greece, Ireland, Russia, Romania, Slovakia and Turkey. Achmea Society offers its products through a wide range of brands. The biggest brands are; Zilveren Kruis Achmea, Interpolis, Centraal Beheer Achmea, Avéro Achmea and Agis zorgverzekeringen. Besides the Dutch brands Achmea is also operating with international brands, such as Achmea Australia. Achmea group is primarily owned by Achmea society

(Vereniging Achmea), which holds 65% of the ordinary shares, every customer is automatically a member of the society. After the take-over of Interpolis from the Rabobank, almost 30% of the shares are in hands of the Rabobank (Achmea A; B, 2014).

Achmea strives to focus on the needs of the customers; they have to be central in their decisions. The aim of Achmea as stated by Willem van Duin, Chairman of the Executive Board: *"We operate in a sector undergoing change and aim to make this transformation in order to maintain our identity in the future: an insurer with cooperative roots and strong brands, one that keeps in touch with its customers by using the latest technologies."* (Achmea B, 2014).
Currently, Achmea is the market leader in the Dutch insurance industry. They are operating primarily in the customer sector as well as in the business sector. The important segments where Achmea is operating are Non-life, Life, Health and Income Protection insurances as well as Pension Products. Achmea's group gross premium in 2013 was 20.2 billion, a net profit of 344 million and solvency ratio, of the insurance entity, of 202%. According to Standards and Poor's (Standards & Poor's rating Services [S&P], 2014), the capital position of Achmea holding is equal to an AA-level investment and the credit rating is equal to A-, with a stable outlook. The insurance entities have an A+ rating with a negative outlook. Achmea has more than 21.000 employees, whereof 4000 employees are working outside the Netherlands. The organizational chart of Achmea is displayed in Figure 1, where the different product and distribution divisions are displayed. The product divisions develop and manage insurances. Afterwards, the products are distributed throughout different channels.

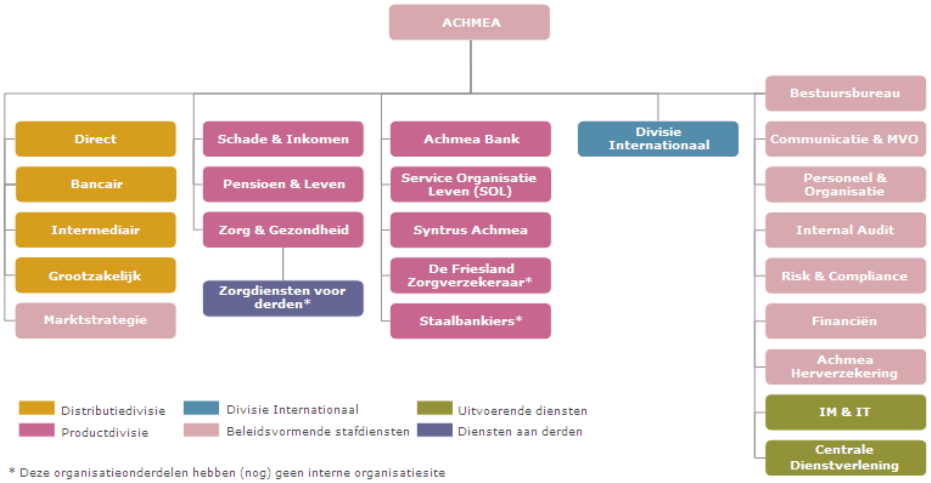


Figure 1: Organizational chart Achmea

The three core product divisions are non-life (schade & inkomen), pension & life (pensioen & leven) and health (zorg & gezondheid). Focusing on the product division non-Life, the main goal is to develop and manage the current non-life and income protection insurances. This includes; the specification of customers' demands, to establish product specifications, the establishment of right premiums, the development of insurances policies and the handling of the received claims. Within this division, the department insurance risk is responsible for development and management of the premiums, provisions and current risks the different insurances are facing. Insurance risk consists of four sub departments; income, non-life private, non-life business and the expert-team. Whereby the expert-team supports the other departments and fulfills Solvency II capital requirements. In the non-life part all non-life insurances are included. Within the Income part, three different categories can be formed; WGA, insurance against long-term partial employee disability (verzuim), absenteeism due to sickness and arbeidsongeschiktheidsverzekering (AOV), disability insurance. Besides the disability insurance AOV, also mortgage payment protection insurance is included in the disability insurance part. Mortgage

Payment Protection Insurance (MPPI), helps clients when they become disabled or unemployed with their mortgage payments. (Achmea A; B; C; D, 2014)

1.3 Problem overview

1.3.1 Problem statement

Insurance, an agreement to adopt the risks someone is facing at an agreed price. The choice for a price or premium depends on a particular product-market combination and the associated risks, (Doff, 2008).

In order to quantify the capital Achmea has to reserve according to the Solvency II regulation for a particular insurance product depends on the risks the product is facing. Focusing on the product "Hypotheekbescherming", from now on referred to as Mortgage Payment Protection Insurance (MPPI), helps clients when they become disabled or unemployed with their (monthly) mortgage payments. When becoming disabled the (monthly) mortgage payments will be paid until recovery, till the end of the insurance or till the end of the insured period. When becoming unemployed the mortgage payments will be paid for a particular time depending on their contract. The premium of the MPPI, which is fixed till maturity, depends on the insured amount for disability and unemployment and the age of starting (Interpolis, 2014).
Due to the Solvency II regulations a particular amount of capital has to be reserved in order to capture the 99,5% confidence interval. Before this can be done a correct premium has to be settled. To determine the right amount of premium, the duration and the probability of becoming disabled or unemployed have to be identified. Furthermore, the risks which Achmea is facing with providing the MPPI have to be covered.

1.3.2 Research goal

This research aims to revise the methodology for the risks quantification for the product Mortgage Payment Protection Insurance in order to assess the financial impact of these risks according to Solvency II regulations. This knowledge is necessary for Achmea, department schade en inkomen, in order to reserve the correct amount of capital according to the risks they are facing. A parameter revision of the premium-model is needed to establish the technical provisions and the corresponding risk capital for the MPPI.

1.3.3 Research questions

Following on the mentioned background and problem statement the following central research question is formulated:

What is the (financial) impact of revising the parameters and foundations of the product Mortgage Payment Protection Insurance (MPPI) respecting Solvency II requirements?

To come up with an answer for the central research question, several aspects have to be researched before. To fulfil this in a structured way the following sub research questions are defined as follows:

- Which requirements does Solvency II impose in quantifying risks for (mortgage) payment protection insurances?
- What does the current literature mention about (mortgage) payment protection insurances taking alone the parameters, premium, provision and risks?
- Which parameters and foundations are needed for the establishment of the premium of the income protection product?
- Which method is used for premium determination?

- What are the risks for the product; Mortgage Payment Protection Insurance and how can these risks be classified?
- What are the consequences for determining the capital for these risks for the Insurance Risk department of Achmea?

1.3.4 Research Outline

This research is organized as follows, starting with chapter 2, a literature review of Solvency II implementations, establishing payment protection insurances, calculation of provisions and a list of risks for payment protections will be given. In chapter 3 Mortgage Payment Protection Insurance, the current product, corresponding risks and the input parameters and foundations for the establishment of the premium are discussed. In chapter 4, the foundations and the important parameters are discussed. As sequel to chapter 4, in chapter 5 the data is back tested, furthermore the premium revision is shown. In chapter 6 the provisions for the product Mortgage Payment Protection Insurance will be determined. The method for retrieving the risk capital for the MPPI is mentioned in chapter 7. The conclusions and a discussion will be stated in chapter 8 and 9.

Chapter 2: Literature review

2.1 Solvency II implementation

The sources, Achmea (2013) and Hull (2010), are used as basis in this paragraph. The goal of Solvency II is, *"to establish an individual risk profile for the insurer, bring assets and liabilities into fair value basis, harmonize standards across Europe and set higher capital requirements to permit timely intervention."* (PUI, 2014). As visible, the implementation of general and well-established requirements is needed. Having decent regulations assists stakeholders to get more comparable information about the status of the company and whether the company is able to survive a crisis.
Looking at the structure of the Solvency II regulations, many similarities with the Basel-regulation can be seen. Solvency II, also consists of three pillars, whereby the first pillar establishes minimum capital requirements, the second pillar establishes the supervisory review and the last pillar states the market discipline. The process of earlier intervention, which means a so-called early intervention and resolution process, which is the basis of pillar II and III, is much more efficient and stable than solo capital requirements (Sijben, 2002).

2.1.1 Capital Requirements

The supervisors are assessing two levels of capital requirements; Minimum Capital Requirements (MCR) and Solvency Capital Requirement (SCR). The level of Minimum Capital Requirements determines the extent in which supervisors have a so called; ladder of intervention which is the difference between the MCR and the SCR. A breach of the SCR will have as consequence the requirement to submit a recovery plan within three months. When breaching the MCR, the consequent requirement is to submit a short term financing plan within one month.
The MCR is to be calculated by means of a pre-set formula regardless whether the SCR is calculated by means of the standard formula or a (partial) internal model. The MCR is influenced by a cap and a floor based on the SCR. The floor is 25% of the SCR and the cap is 45% of the SCR unless the absolute MCR is reached. This is 2.500.000 for a non-life insurance and 3.700.000 for a life insurance (Achmea, 2013).
The SCR, target capital, can be calculated with two different methods, the standard approach or the (partial) internal model approach. The committee proposes a standard approach. If insurance companies are able to formulate models which fit better to their own risk appetite, internal models are allowed. These internal models have to be approved by the De Nederlandse Bank (DNB), whereby the model has to satisfy three tests; a statistical quality test, a calibration test and the use test. Establishing a model for some of the risks might be impossible due to missing data or forecast possibilities. Therefore a lot of companies are using Partial Internal Models (PIM) whereby the company use their own model if available, otherwise they uses the standard model (De Nederlandse Bank [DNB], 2014).
The SCR, corresponds to the Value at Risk, VaR. The VaR is a widely used measure which corresponds to a loss that will not be exceeded at a specific confidence interval. Given a particular insurance product, a probability and a time-horizon, the VaR can be defined as threshold value such that the probability that the loss for that specific product over the given time-horizon will not exceeds this value. In Solvency II, the confidence level of 99.5% and a one-year time period are used. For computing the VaR the following assumptions; normal markets and no trading in the portfolio, have to be made. The most important risks an insurance product is facing are non-financial risk, investment risk and underwriting risk (Doff, 2008; Achmea B, 2012). Combining and diversifying the VaR of the different risks gives a VaR of a particular insurance product.

2.1.2 Supervisory Review and Market Discipline

In the first pillar the company tries to identify and quantify the risks for a particular insurance product, with the second pillar the focus is on the supervision of earlier mentioned risks and the third pillar focuses on reporting of the earlier mentioned risks. The supervisor will observe, verify and quantify all the risks a product is facing. Furthermore, the risks which cannot be assessed properly are reviewed in order to reserve enough capital. A new assessment, the ORSA, Own Risk and Solvency Assessment is a tool which can be used for the decision making process and the strategic analysis. It gives an overview

of all the separate risk-management-aspects. The ORSA is included in the yearly report to the DNB and the other stakeholders. The aim of this regime is; to identify, assess, monitor, manage and report the short and long term risks (CEIOPS, 2008). Allow earlier regulatory intervention and become risk sensitive and capture risks which arise from taking care of business. The third pillar focuses on disclosure and transparency. Information of the risks an insurer, a particular department or a particular product is facing has to be disclosed to all the shareholders. (DNB, 2014; Achmea A, 2012)

Solvency II will foster companies to manage their risks, value their liabilities using economic principles and keep adequate capital to absorb the risks. Along focus of this research the first pillar, capital requirements is our current focus whereby Solvency II will be used as standard for establishing the "right" amount of capital.

2.2 Mortgage Payment Protection Insurance

A PPI, Payment Protection Insurance, provides coverage for a consumer in case the customer becomes unable to fulfil his (monthly) payments. Generally, the risks accident, sickness, unemployment and in some cases the risk to life are included with a PPI. A PPI product is generally associated with a loan product; therefore having a PPI to protect a borrower's ability to maintain loan repayments. PPI policies are on hand for a wide range of personal credit. The most important are; first-charge mortgage payment protection insurance, second-charge mortgage or secured loan PPI, unsecured loan PPI, credit card PPI, store card PPI whereby the first mentioned PPI will be the focus in this research. (European Insurance and Occupational Pensions Authority [EIOPA], 2013; Office of Fair Trading [OFT], 2006)

According to Jenkinson (1992); "Housing is a unique good", it has an important role in security and social structure to individuals and households. Furthermore, housing has a role in shaping our lives and communities which other goods does not have. Compared to all forms of ownership, homeownership is the most satisfying for the individual but also most beneficial to the nation as stated by Hamnett (1999). Keoghan and Pryce (2001) mentioned that homeownership is the best saving, therefore there can be stated that homeownership is an addition to our lives.
A Mortgage Payment Protection Insurance (MPPI) helps insured people to pay their mortgage. According to Pryce and Keoghan (2001), *"MPPI policies are private insurance products, designed to protect mortgage borrowers against the risks of accident, sickness or unemployment."* In any of these cases the insurer is obligated to cover up the insured person with their monthly mortgage payments up to the insured period. In order to be eligible a customer has to fulfil the following requirements; has to work and live in the Netherlands, is aged between 18 and 65 years old, works for more than 16 hours a week and has a contract for a specific time-period (OFT, 2006). Due to legislative changes, the AOW pension age has changed, consequently the person have to be aged between 18 and AOW pension age. Focusing on the MPPI, it can be seen that the insured amount, the age and the insured time-period are the parameters which are most important for establishing the premium for a particular person. In line with a person's monthly mortgage payment an X amount can be insured. The time-period of the insurance can be settled with as maximum the maturity of their mortgage. Furthermore, the insured time-period; maximum of 12 months for unemployment and up to 20 years for disability, have to be chosen (Interpolis, 2014). Finally, the current age of the person has to be known before taking into account the risks to which the insurer is exposed to.

Benefits from having an MPPI; policyholders will not default on their mortgage and will not face the repossession of their home (Ashton & Hudson, 2011). Reasons for being unsecured; they are in stable forms of employment, have financial resources to cover up the payments when needed, they cannot afford the premium and/or the product is not relevant for the customer because the most important risks are not covered by the MPPI (Keoghan & Pryce, 2001).

As can be seen above an MPPI looks as an ideal product, covers up the risks a homeowner faces, but as Keoghan and Pryce (2001) and OFT (2006) appoint, only a small percentage of homeowners do have an

MPPI. Looking at the other categories of the PPI product the percentages are even lower. Besides the mentioned reasons for being unsecured there are more reasons why homeowners are unsecured. Until recently, PPI products were hard to understand, had a low claim ratio and high commission rates compared to other insurance products. Furthermore, the explanation of the pricing of the products comparatively to the coverage and the less competitive market were indications that the customers received poor value from their insurance (OFT, 2006). Due to missing knowledge about the price, product, possibilities and necessity, customers were not able to estimate the need for an MPPI.

The mentioned problems above are caused by misrepresentative information and market imperfections. There can be spoken of misrepresentative information when the customers receive information that "unfairly" change their choice. As illustration; generally, PPI's are sold at the same time with establishing a credit agreement and both are arranged by the lenders. In some of the cases the customers do not know that the mortgage and the insurance can be sold separately, they think it is an integral part of the loan product. In line with this, some of the lenders insist of taking out an insurance together with a loan while it is not a mandatory requirement before obtaining credit (OFT 2006 & EIOPA, 2013). Most of the problems are caused by market imperfections. Due to the limited availability of the information about PPI products, it is hard to compete with the other PPI products therefore "higher" prices than needed are charged. Furthermore, the PPI products are complex and the customers showed limited financial capability when purchasing the PPI. Due to all the different possibilities; which risks have to be secured, which amount has to be secured, the maturity of the insurance and the insured time-period makes it opaque. Focusing on MPPI products, the same problems rise, only the extent to which this occurs are much smaller (OFT 2006 & EIOPA 2013). The market for MPPI products is bigger; more customers are insured and more companies offer this type of product. Still, by clarifying the market, competitors, possibilities and conditions the earlier mentioned problems can be reduced. Focusing on the MPPI market in the Netherlands, the AFM, Authority for Financial Market, is active in improving the product in order to receiving a good value for the customers from their insurance (AFM, 2014; EIOPA, 2013).

2.3 Premium model MPPI

Modelling a premium for an MPPI is difficult due to the two different methods. Where normally products with a disability cover are calculated with the life-method, products with an unemployment cover are normally calculated with a non-life method. Focusing on an MPPI there can be seen that both, disability as well as unemployment can be insured in an MPPI. First a choice towards one of the two methods has to be made. Assigning a method also effects calculating the provisions and defining the risks the MPPI is facing. For the MPPI in the current literature no choice towards one of the methods is made.
Focusing on the disability part, there can be seen that the mortality, morbidity and the recovery rates are the most important risk-aspects which influence the premium level for the disability part. For the unemployment part, which consist of short-term payments, the duration and probability of becoming unemployed is important. Below a universal method for provisions and the risks a MPPI is facing are described.

2.4 Technical provisions MPPI

Provisions; something that is done in advance to prepare for something else, (Merriam Webster, 2014). Technical provisions are in accordance with International Association of insurance supervisors, IAIS; "*The amount that an insurer sets aside to fulfil its insurance obligations and settle all commitments to policyholders and other beneficiaries arising over the lifetime of the portfolio, including the expenses of administering the policies, reinsurance and of the capital required to cover the remaining risks."* (International Association of insurance supervisors [IAIS], 2014). Normally technical provisions are the largest item on a balance sheet for an insurance company therefore a proper calculation is essential for

constructing a pure balance sheet. Solvency II uses the balance sheet as a regulatory-tool to check the insurer whether the company is solvent.

The technical provisions are intended to display the current amount the insurance company would have to pay for an immediate transfer of its obligations to a third party. The technical provisions consist of two components; the best estimate of the liabilities plus a risk margin. Whereby the liabilities consist of claims and premium provision. The claim provisions are the discounted best estimate of all the future cash flows relating to the claim events prior to valuation date. The premium provision is the discounted best estimate of all future cash flows relating to future exposure arising from policies that the insurer is obligated to at the valuation date.
The definition of the risk margin, according to Solvency II; "*The risk margin shall be such as to ensure that the value of the technical provisions is equivalent to the amount insurance and reinsurance undertakings would be expected to require in order to take over and meet the insurance and reinsurance obligations."* (Achmea, 2013; The Institute and Faculty of Actuaries [IFA], 2013)

2.5 Risks for Mortgage Payment Protection Insurance

The sources, Achmea (2013); Doff (2011) and Hull (2010) are used as basis for this paragraph. An insurance company takes care of the customers' risks. In return they receive a premium, hereby is the customer assured. From all the received premiums an insurance company can cover their costs and pay the customers which made a claim. In the long run, the income and the expenses will be equal but the number of claims can be fluctuating during the years. These expenses can first be covered by the prudence in the technical provisions and secondly by the capital. Doff (2006) risk is defined as "*the phenomenon where results can be worse than expected*". The total risk spectrum can be divided into several categories; investment risk, underwriting risk and non-financial risk. Knowing the risks to which an insurer is exposed, brings us to the next step; controlling and measuring the risks. Within risk management; the risks can be controlled, financed and reduced. To control the risks, a company has to observe the risks and tries to minimize the risks with precautions. The focus of financing the risks is to prevent the financial consequences with reinsurance. Finally, reducing the risks by stopping that particular risky activity. Whenever stopping is not possible, diversification is a possibility to reduce the risk. Knowing the current risks an insurer is facing, the risks have to be measured, with use of economic capital, to give a minimal capital requirement. Economic capital is derived from the Value at Risk, VaR, which is a measurement for the risk associated to a particular business activity. Economic Capital according to Doff (2006): economic capital is the minimum capital available for potential calculated setbacks. Knowing the different VaRs as well as the economic capital for the different risks of the different activities, a general VaR with a certain economic value can be given (Achmea B, 2012; IFA 2013). For taking more risks, higher fluctuations in return are the result, sometimes high positive returns and sometimes losses. To prevent for taking more risks, higher capital requirements are needed. Figure 2 presents an overview of the different VaRs belong to the different capital requirements, knowing a particular VaR percentage, a corresponding capital requirement can be given. With a particular credit rating an insurance company has a change of bankruptcy can be viewed. Taking a lot of risks and reserving less capital, belongs to a lower credit rating, BBB, which means more chances of failure. Within Achmea, the regulatory capital, as discussed in the Solvency II manual, is equal to the economic capital which is used in this research.

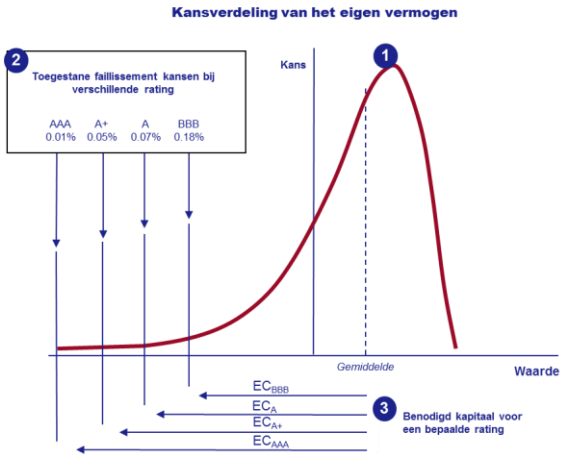


Figure 2: Economic capital definition

2.5.1 Investment risk

Focusing on investment risk, three important subcategories can be mentioned; market risk, credit risk and liquidity risk. Market risk can be defined as a decrease in value by changes in the market variables; this includes Asset & Liability Management (ALM). Within market risk, the following subcategories can be presented. Interest rate risk, equity risk, currency risk, inflation risk, real estate risk, private equity risk and credit spread risk. Whereby Interest rate risk is caused by changes in the interest rate which influence the value of the assets as well as the value of the liabilities, therefore this is the most important subcategory of market risk. Furthermore, all the risks are caused by a decrease in value due to a change in that particular subcategory. The best instrument for controlling market risk is creating a decent investment plan which is in line with the asset and liability management.

Credit risk is the risk of decreases in value when counterparties are not capable of fulfilling their obligations or due to changes in the credit standing of counterparties. When having only government bonds, the insurer would run no credit risk because it is certain that the bond will be repaid at maturity. To obtain higher returns, insurers invest in corporate bond and mortgages which evolve more credit risk. Furthermore, the insurer is doing business with reinsurance counterparties and derivatives counterparties, whereby also credit risk is evolved. Spreading is the key to control credit risk, for bonds, reinsurances and derivatives. For mortgages, collateral is the instrument to avoid losses.

Doing business insurers needs liquid assets to pay policyholders. Simultaneously they receive liquid assets from premiums, normally these two are not equal to each other. Therefore an insurer strives to have sufficient liquid assets on hand. Having large financial disruptions such as natural disasters evolves usually liquidity issues. Liquidity risk is the risk of having unexpected high payments where complying with liabilities involves a loss. With a day to day basis of specific attention to liquidity risk is required, including a detailed liquidity analysis.

2.5.2 Underwriting risk

Within this category; life and non-life risk can be positioned. Where in the past life and non-life insurances where nicely separated nowadays they are combined, for example the MPPI. Life-insurances are insurances which are associated to the life probabilities of a person. The risk increases/decreases in value due to different longevity/mortality than expected. Life risk can be divided into three subcategories; longevity risk, mortality risk and disability risk. Disability risk can be divided into incidence, recovery, catastrophe, expense and revision risk. To control these risks, diversification in the portfolio is needed to cover the longevity and mortality risk. For disability risk healthy life-styles or reinsurance can be an option for reducing some of the risks.

Non-life insurance, an insurance where the insurer promises to compensate a certain loss which is not associated to the “life” aspect. A wide range of insurances, fire insurance, income insurance, building protection etc., are offered. Non-life risk captures the risks from a decrease in value by different or higher claims than expected or by a change in expectations over time. Non-life risks can be divided into four categories; premium risk, the risk that during the year the claims will be exceeding the premium-

income; reserve risk, the risk that additional technical provisions for previous years' reported claims are necessary, catastrophe risk, the risk of large-scale catastrophes such as natural disasters and expense risk, the risk that the costs are not covered by the premium income. To control these risks again portfolio diversification and reinsurance are needed to or reducing some of the risks.
For an MPPI product, underwriting risk are the most important ones due to the magnitude (Achmea, P@R).

2.5.3 Non-financial risk

Within the last category, operational and business risks are included. Particularly the banking sector has given attention to operational risk during the last decennia. Where in the past operational risk was defined as everything minus market and credit risk, nowadays it is much more structured. Operational risks; are the losses due to shortcomings in internal or external events; such as failures in processes, people, and systems. One of the key features of operational risk is that it can be influenced by the company. With controlling and transferring the risks; internal control, physical control, business continuity, workplace conditions risk awareness and risk governance and organization, a company can reduce the risks.
Business risk includes the risk of losses due to changes in the competitive environment or internal flexibility, also known as "rubbish bin". To create an image of the current position in the market a periodical strategic analysis of the competitive environment and an overview of the cost structure can be helpful. (Ashly, 2011)

2.6 Conclusions

Sijben (2002), the structure of the Solvency II requirements with the three pillars, is more efficient than solo capital requirements. Where pillar I, capital requirements, is the most important pillar for insurers, pillar 2 & 3 are necessary for review and disclosure.
Within pillar I, the MCR and SCR have to be calculated. With use of the (standard) approach or (partial) internal approach, the SCR can be settled and from there on the MCR can be distracted.

The MPPI, Mortgage Payment Protection Insurance, an insurance which helps insured people to pay their mortgage in case of being unemployed or disabled. Besides the benefits, MPPI products are hard to understand, have a low claim ratio, high commission rates and operate in a low competitive market. Clarifying the market, competitors, possibilities and conditions of the MPPI and the product group in general can improve the MPPI.

Technical provisions; an amount the insurer has to reserve to fulfil its insurance obligations and the settled commitments to the policyholders and beneficiaries during the lifetime of the portfolio. Technical provisions consist of three components; claim provisions, premium provisions and a risk margin.

Risk is classified as worse than expected, which can be divided into three categories. Investment risk, consist of market, credit and liquidity risk. Captured all the risk due to interest, currency, inflation, counterparties and payment obligations. Underwriting risk consist of life and non-Life risk. Risks arising from mortality expectations, such as volatility and trend fluctuations, belong to life risk. Non-life risk, is the most important risk for MPPI products, captures all the risk arising from decrease in value or "higher" claims expectations over the time due to premium, reserve or catastrophe risk. The last category is non-financial risk; which consists of operational risk, losses due to shortcoming in internal or external events and business risk, losses due to changings in the competitive environment. After identifying the risks the minimization and controlling of these risks is important furthermore the risks have to be capitalized to quantify the risks and reserve enough risk capital.

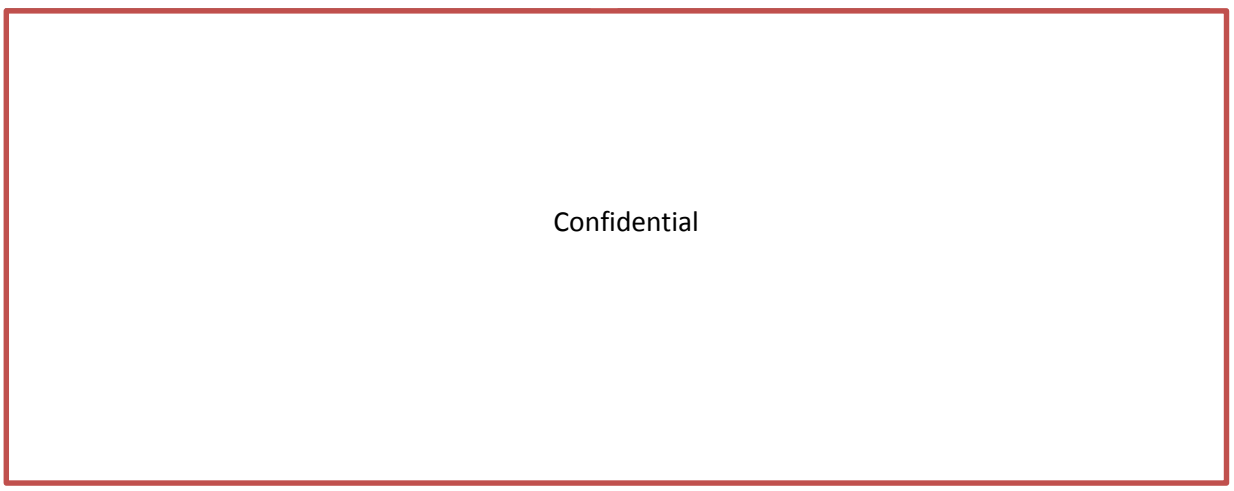
Chapter 3: Mortgage Payment Protection Insurance

Focusing on the Netherlands, eight different parties are offering a MPPI. The brands which offer a MPPI are; ABN Amro, Credit Life, Delta Lloyd, TAF, TWG, Woongarant and Interpolis according to the Consumentenbond (2012). The products vary from names, policy conditions, different possibilities and different amounts of premium.

3.1 The current MPPI

The source Interpolis (2014) is used as basis for this paragraph. Currently the focus is on the MPPI, which is offered by Interpolis. Interpolis is since 2005 a brand of Achmea Holding NV, and offers a wide range of insurance products; health, life, car and travel insurances, in cooperation with the Rabobank. For disclosing an insurance of Interpolis, the intermediary, Rabobank, has to be contacted. The MPPI Interpolis offers is Hypotheekbescherming; an insurance which protects a homeowner(s) against disability and/or unemployment. In order to have an insurance-cover the requirements mentioned in paragraph 2.2 have to be fulfilled.
Before closing an MPPI insurance the client has different choices within the MPPI Interpolis offers. When closing an MPPI, the client first has to choose for which amount he/she wants to be insured, most often this amount is equal to their monthly mortgage payments. Disclosing an MPPI insures a person against disability furthermore the client has the possibility to protect besides disability also unemployment, when this is the case also an unemployment amount has to be given. Next, an insured time period for disability as well as for unemployment have to be given. For disability, a time-period between 4 until 20 years can be insured, with a deferment period between 0 and 2 years. For unemployment, a period of 3 months or 12 months is insured depending on your employment contract. The maturity of the insurance have to be set, most often is chosen for the fixed-rate period or the maturity of the mortgage. After reaching maturity, the insurance stops or can be extended. Furthermore, the date of birth has to be given. Closing the insurance, the clients have the possibility to close the insurance for one or two persons, within one insurance. This coincides with the two earners mentality. Afterwards, a constant monthly premium can be given until the maturity.

Since 2005, the current MPPI product is sold towards the clients. In the past Interpolis took over a MPPI portfolio, mentioned as old product within this research. The old product protects homeowners besides disability and unemployment also for serious illness. Furthermore, there are some small differences between the two products; these are showed in Appendix B: Policy conditions Hypotheekbescherming. Due to the recent launch of the new product and the similarities of both products, in some of the analyses also the results of the old product will be taken into account. Currently, the MPPI portfolio of Interpolis consist out of circa XXXXX old policies and XXXXX current policies, which gives a total of XXXXX policies and the associated XXXXX insured persons. In Figure 3 A & B, the development of the number of policies and number of insured persons during the last ten years are given.



3.2 Risks

In order to establish a correct premium with the corresponding provisions and capital requirements the current risks for the MPPI of Interpolis have to be clarified. Within paragraph 2.4 the most important risk categories; investment risk, underwriting risk and non-financial risk, for insurances companies are described. In this paragraph, the risks which are relevant for a MPPI product will be discussed.

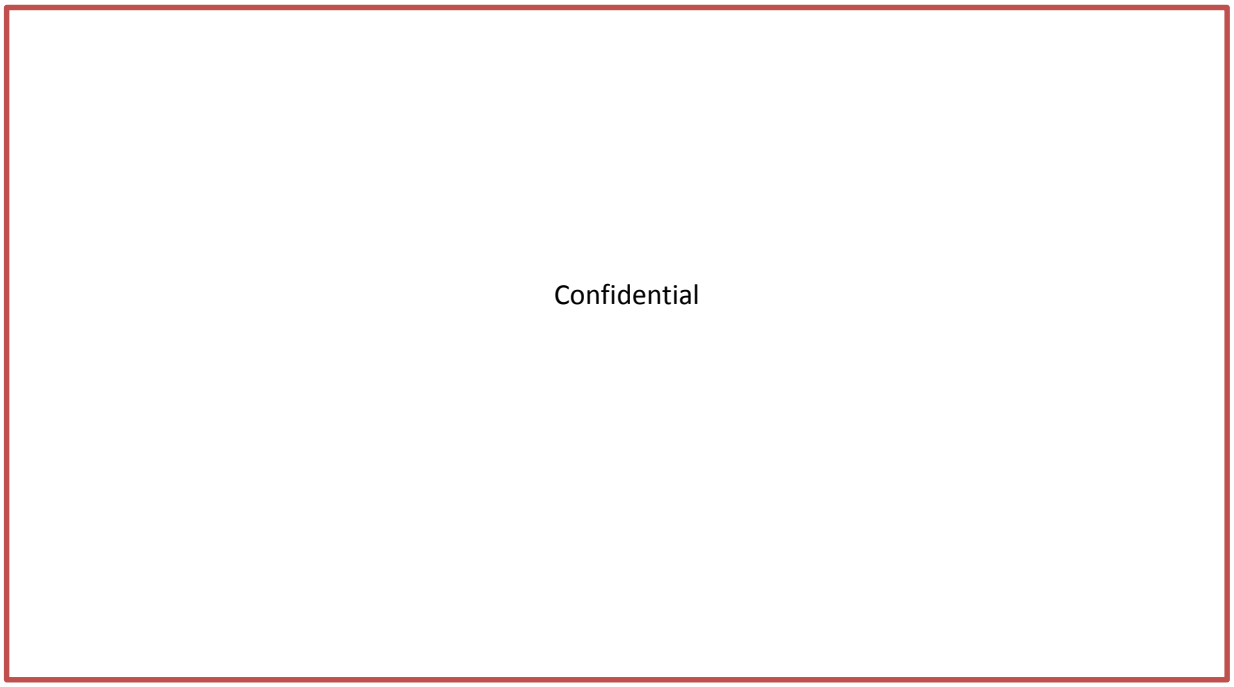
Figure 4: Risk tree MPPI

Where in the literature VaR is used to estimate the Value at Risk within Achmea P@R (Profit at Risk), is used. Whereby the P@R, has to cover all the losses for a specific interval established by the credit rating of the insurance company. Achmea defines P@R, 99,5%, as the required capital to cover the extreme scenario which happens every 200 years (Achmea C and D, 2012).

Almost everything can be insured, from a car to a disability. Whereby the payout period can vary between, once or monthly for the rest of your life. In line with this it is observable that the probabilities and the risks are different and have to be established with different methods. Therefore the life method as well with the non-life method can be used. The non-life method, handles damages which are mainly short term, the life-method on the other hand is many long term. Within Figure 4, the risk tree for a MPPI is presented. Whereby a split within the underwriting risk can be made caused by the different methods. As described in chapter 2, life as well as non-life aspects are represented in a MPPI. An MPPI is exposed to the risks and the associated sub-categories as displayed in Figure 4. Using the life-method the yellow boxes have to be established, using the non-life method the red boxes have to be established. Besides the mentioned risks belonging to one of the two methods the MPPI is also exposed to some domed risks, which are displayed with pink.
In order to establish the best estimate for the different risks, the disability part of the product have to be calculated with the life-method, the unemployment part have to be calculated with the non-life method and the domed risks with the method provided for this purpose. By the size of the MPPI product, calculating the disability and the unemployment part separately is not efficiently. Therefore a

choice for life or non-life has to be made. Independent of the method the risks of the MPPI will be the same and have to be estimated as accurately as possible. Where in the life-method is spoken of the incidence risk within the non-life method there is spoken of the premium risk. The name and method of calculating the risk is different but in both cases it has to cover the same risk, the same applies for recovery risk and reserve risk whereby the recovery probabilities have to be taken into account. Evidently for the catastrophe and expense risk, both methods differ but the same risks are estimated.

In 2012 as well as in 2013 and 2014, the MPPI was categorized as a non-life health insurance. For establishing the P@R of the MPPI this resulted in a different amount as presented in Table 1. Resulting, in 2012 more capital has to be reserved than in 2013 and 2014. Additionally, is the counterparty default risk, in 2012 this was determined Achmea-wide and since 2013 this is done division-wide.
Overall, there can be concluded that the premium and reserve risk are the most important ones. Premium risk is defined as the risk of having insufficient premium income to pay for new claims where reserve risk is defined as the risk that the provisions for the ongoing claims, are sufficient. In order to reduce these risks, establishing a well based premium and technical provisions are needed by using the best estimates for incidence and recovery probabilities. Within chapter 7, the choice for life toward non-life, the kind of method stand-formula or (partial) internal model will be discussed more into detail.



3.3 KAZO-model

In the Netherlands, the KAZO-model (Kontactcommissie voor Arbeidsongeschiktheid-, Ziekte- en Ongevallenverzekeraars) is used as the standard model for pricing and provision calculation for disability insurances. The result is described by Gregorius (1992) and nowadays known as the KAZO-model. With help of the KAZO-model the incidence rates and the recovery rates, can be estimated. The KAZO-model is a Markov-type model and consists of eight different states, A, I(1) to I(6) and D, as visible in Figure 5, the original model as stated by Gregorius. The A represents the active state, this are policyholders who are healthy, not claiming. The I(1) to I(6) represent the state of disability, I(1) represents the first year of being disabled, I(2) the second year etc.. I(6) represents the disability of 5 years and longer because there is assumed that recovery after the fifth year is equal to zero. D, death, represents the policyholder who dies. The possibility, called a transitions probability, to switch from state to another state, is denoted with an arrow. From the active state it is possible to become disabled, move to I(1) or die, move to D. When becoming disabled and still being disabled after a year, the move to I(2) is made, ect.. From I(1) till I(5) the policyholder can recover and therefore return back to A, or also die as given with the arrows. From state I(6) a policyholder cannot recover so only the die-arrow is drawn. As visible the D, death is an absorbing state, it is not possible for policyholder to return to another state.

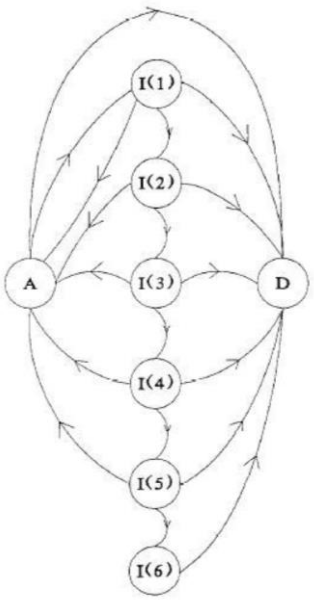


Figure 5: The graphical representation of the KAZO-model

After explaining the figure, the transition probabilities which belong to the arrows will be discussed below. The research on which the KAZO-model is based, has to less observations to derive own mortality rates, therefore the GBM 1980-1985 mortality table is used. The probability to die can be given with q(x), which depend on the age, x, of the policyholder but are equal for all the seven arrows towards the D-state. These probabilities are treated equally in the KAZO-model, by the assumption that the mortality rates are equal for the actives and the disabled. This means that the degree of disability is not taken into account for estimating the maturity. i(x), the incident rate, the probability of becoming disabled denoted on the arrow from A to I(1). Formula 3.3.1, represents the incident rate for a certain policyholder with age x. Formula 3.3.2, represents the recovery rate, percentage for a policyholder with age x who has been disabled for d years, denoted as r[x-d]+d or defined as r[x,I(d)].
Resulting two general formulas, for the incidence and recovery probabilities are derived, as given in formula 3.3.3 and 3.3.4.

$$i(x) = 0.00223 * 1.0468^{x}$$
$$x = age\ of\ the\ policyholder \tag{3.3.1}$$

$$r_{[x,I(d)]} = 1.24111 - 0.02219$$
$$r_{[x,I(d)]} = 0.66499 - 0.01153x$$
$$r_{[x,I(d)]} = 0.27394 - 0.00532x$$
$$r_{[x,I(d)]} = 0.23547 - 0.00470x$$
$$r_{[x,I(d)]} = 0.14166 - 0.00319x$$
$$r_{[x,I(d)]} = 0 \tag{3.3.2}$$

$$x = age\ of\ the\ policyholder$$
$$d = number\ of\ year\ disabled, d = 1, \dots, 6$$

$$i(x) = a * b^{x}$$
$$x = age\ of\ the\ policyholder \tag{3.3.3}$$

$$r_{[x,I(d)]} = a(d) - b(d) * x$$
$$x = age\ of\ the\ policyholder$$
$$d = number\ of\ year(s) disabled, d, \dots, 6 \qquad (3.3.4)$$

The unemployment premium determination is derived from the KAZO-model as well. The unemployment probability, the average duration and the mortality rate for a specific age are taken into account. The unemployment part is a short time, maximum 1 year, taken the employment probabilities with the maximum duration instead of the average duration is too cumbersome. The unemployment probability times the average duration for a specific age category corrected by the mortality rate is the way to calculate the unemployment part of the premium.

Passing time, the KAZO-model is updated with recent data. Furthermore, the interest rate is change from 4% into 3% and 5 instead of 4, occupational classes are taken into account. Within the current premium model, no distinction in occupational difference is made. The rates which belong to the third occupational class, the median, are used within this model. Currently, a more up to date q(x), r(x) and i(x) are used for premium and provision determination. Provisions are currently settled at the potential maximum damage. When becoming disabled the monthly payment for the maximum duration is reserved.

3.4 Method

3.4.1 Premium model

In order to realize a revised premium, recent probabilities of becoming disabled or unemployed have to be implemented in the model. Therefore internal or external data can be used. In 2005, the current premium model is based on external data since the product was launched newly. Therefore external data on disability and unemployment with some correction factors were implemented. By changing the product conditions in 2009, some new disability and unemployment probabilities were implemented but no in-depth research or back testing was performed.
First some background research has to be conducted before choosing which data can be used as input. Therefore the internal data of the MPPI which is gathered have to be investigated. To have an “equal” age spread throughout the portfolio in some of the cases also the old product is taken into account. After reviewing; payout amounts, payout durations, outliers, probabilities and payout reasons, the disability and unemployment probabilities become clear. Furthermore the national probabilities for disability and unemployment of the last decade have to be gathered. Then, the different probabilities can be compared, will be performed in chapter 4.

3.4.2 Provisions and risk capital

After the revision of a premium model, the current provisions method with assumptions and the underlying data have to be reviewed in order to check whether the provisions are adequate but not too cautious. Finally, when needed, the provisions can be adjusted. These adjustments must ensure the new provisions are established as best estimated, as required in Solvency II.
Afterwards, the risks can be reviewed, what are the revision possibilities and what are the methods to derive the capital requirements. In order to make a decision about the capital requirements, as result of the risks, the internal data should be addressed. The risk capital determination methods have to be reviewed. The MPPI is a unique product therefore the achieved results are useful but the data history must meet certain requirements and must contain sufficient history. Within chapter 6 the provisions and chapter 7 the risk capital, will be discussed.

3.5 Input parameters & foundations

Subsequently, the parameters which are needed for giving a monthly premium have to be debated. Focusing on the premium-model different parameters and foundations are incorporated. Furthermore, a distinction between client and Achmea dependent is displayed. When there are two persons insured, some of the variables have to be filled in two times.

Client dependent	Description
Client Characteristics	
Date of birth client(s)	Depending on the date of birth, the entry age and the final age can be defined
Number of insured client(s)	Depending on the request, 1 or 2 persons can be subscribed within one insurance
Client choices	
Deferment period disability	Whenever disability occurs, the client has an own risk period. He/she can choose between; 0 months, 1 month, 1 year or 2 years. When the client is still disabled after the deferment period the payouts starts. Can vary between clients within 1 insurance.
Insured amount disability	The monthly amount for which a client want to be assured, whenever disability occurs. Client dependent, can vary between clients within one insurance.
Insured amount unemployment	The monthly amount for which a client want to be assured, whenever unemployment occurs. Client dependent, can vary between clients within one insurance.
Insured time-period disability	The insured time-period for which a client want to be assured, whenever disability occurs. The period has to be between the 4 and 20 years, person dependent.
Insured time-period unemployment	Depending on the kind of employment contract a clients has. When have a fixed time contract, the insured time is 3 months when the client have an indefinitely contract, the insured time is 12 months. No deferment period for the unemployment part is used.
Maturity of the insurance	The duration of the insurance, most often equal to fixed-rate period of mortgage or till maturity of mortgage. Is calculated with the start date and end date of the insurance

Table 2: Client dependent

Achmea dependent	Description
Achmea - Parameters	
Acceptation	Charge for a health check. Currently not used but due to possible legislative changes this can be needed.
AO-criterium, Occupational class and benefit-scale	Currently everyone is categorized in the same class. But there is an option to add some extra premium for particular classes.
Ascension rate	An ascension rate can be added due to inflation. With help of the ascension rate increase due to economic fluctuations can be handled.
Costs - variable	Variable costs claim for handling costs and assessment costs depend on insured amount.
Costs -fixed	A fixed amount of costs is incorporated.
Extra waiting time	When closing the insurance an extra waiting time has been added. After these months, the change comes into effect.
Interest rate	The interest rate is implemented in the premium model. The rate depends on the current yield curve.
Solvability charge	Needed in order to reserve enough capital for fluctuation in earnings. Also the profit margin due to the capital reserves is added furthermore upcoming trends in disability and unemployment have to be taken into account.
Temporary cover	A temporary cover is when a client becomes disabled or unemployed in the period between closing a mortgage with an MPPI and buying a house. The payout starts after the deferment period of the client. To ensure these risks an extra charge is added.
Term addition	To cover the risks in line with the monthly premium payments and term addition is added.
Achmea- Foundations	
Contracted or self-employed probabilities	Depending on kind of employee, contracted or self-employed, different probabilities have to be taken into account. In this research only the contracted probabilities are taken into account due to the portfolio distribution. In the current portfolio 98% are contracted employees.
Duration unemployment	Average duration unemployment depends on the age of the client, needed in order to estimate the average unemployment duration.
Mortality	Probability a client will die, age dependent.
Morbidity	Probability a client becomes unable to work, age dependent.
Retention rate disability	Probability a client remains disabled, age depending.
Unemployment probabilities	Probability a client becomes unemployed, age dependent.
Unemployment correction	Due to the difference between national unemployment and reality a correction factor is needed.

Table 3: Achmea dependent parameters and foundations

After mapping the variables which are important for establishing an MPPI, the foundations will be discussed, within chapter 4 data.

3.6 Conclusions

Within this research the Mortgage Payment Protection Insurance, MPPI, is the focus. The internal used dataset and the specific product information is retrieved from Interpolis a brand of the mother brand Achmea. Taking out the insurance, different choices towards protection possibilities have to be made, the disability part is protected but the unemployment protection is a choice. Furthermore, choices towards the insured amount(s), maturity of the insurance, the insured duration and the deferment period have to be made.

For the MPPI, the reserve and premium risks are the most important ones due to their size. Currently, these risks are determined with the standard non-life method within chapter 6 the risk capital methods are is discussing in more detail.

Currently the disability part of the MPPI is based on the KAZO-model as described by Gregorius in 1992. For the unemployment part of the MPPI a simplistic version of the KAZO-model is used. Passing time, more up to date probabilities are implemented within the KAZO model. In chapter 4, the newer probabilities are discussed.

Lastly, the input parameters and foundations are explained; these can be categorized in two groups, client and Achmea dependent. With the client group a further distinction can be made; client characteristics and client choices. The Achmea dependent group can also be split in two groups, parameters and foundations. These foundations correspond with the risks the MPPI is facing. Hereafter, in chapter 4, the foundations and some of the parameters will be discussed in to more detail.

Chapter 4: Data selection

In this chapter the data for the foundations is selected. The risks the MPPI is facing emerge from the foundations of the MPPI. With respect to Solvency, the goal is to provide the best estimate probabilities for the foundations and the parameters. For the foundations and parameters no conservatism will be taken into account. The earnings are included in the solvability charge.

4.1 Disability data

In this section the reasons why clients receive a payout will be discussed. The morbidity, recovery and mortality rates are very important for disability probabilities. First the internal realized rates will be discussed afterwards the external rates. As third the internal and the external data will be compared. Finally a suitable disability dataset is chosen.

4.1.1 Internal disability data

First, the registered disability claims by Achmea are observed. Within the claim history the old product as well as the current product is included, due to the small chance of disability and the more equitable age distribution. Within the history all the incoming claims are registered, these are the claims which would receive a payout, in first instance. Due to rejection, contract clauses, concealment, passing away or recovery within the deferment period the payout can be canceled. In Appendix E: Disability summary- Achmea, the reasons for ending a claim are shown. The list of abbreviations is presented in Appendix A: Glossary . As is shown in the disability summary of Achmea, more than 50% of the time, the client recovers between the submission of the claim and the end of the payout period. Besides recovery, “the maximum of the disability period reached” and “maximum of unemployment period reached”, are important reasons for ending the payout. This last reason is used when a person first becomes unemployed and later on also becomes disabled. Because the ending reason cannot be changed in the system, this title is used but the payout is booked under disability.

Next, some important product differences between the old and current product and some improvements within the current product will be discussed. In the current product a deferment period is included to assure long term disability is covered instead of short term disability. Most often short term disability is caused by illness, to avoid protecting for short illness, the serious illness part is excluded and a deferment period is added. In line with this change, the payout probability for disability is lower because within the first two years recovery is more likely. Besides the deferment period difference which exists only in the current product. Also the insured time period for disability is different between the old and the current product. In the old product 2, 3 or 4 years can be insured where in the current product a period between 4 and 20 years can be insured. For the current product, people most often choose for a coverage period of 4, 8, 12, 16 or 20 years.

Within Figure 6 A and B, given on the next page, the percentages of the yearly new insurance policies with their chosen insured disability period are displayed. Looking at Figure 6A, a wildly varying graph is displayed. This graph confirms the expectations. Before 1997, the old product is introduced with a disability period of 2 years, in 2000 a disability period of 3 years is added and one year later also a 4 years period is added. In 2005 the current product, with a disability period of 4, 8 or 12 years is introduced and later on in 2009 also the periods, 16 and 20 years, are added as options. All the mentioned changes are visible in the Figure 6A.

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As result, there can be concluded that the disability payout has changed over time, where in the beginning immediately after disability the payout started. Nowadays a period between the 0 and 2 years must be bridged but afterwards a longer period is insured. Focusing on the current product only, in Figure 6B the spread of the new insurances with their duration choice is displayed. There can be concluded that the 4 year period is the most commonly chosen option, always above 62%. In Appendix D: The chosen insured time period disability, the associated data of the graphs is shown.

Knowing a bit more about the duration possibilities and the customer's choices, the data of the observed claims can be reviewed. As stated in Appendix E: Disability summary- Achmea, the average duration of a claim will vary between XX and XX months, depending on which claims are taken into account. This difference can be explained by the difference in policy conditions of the old and current product. Looking at the difference in payout duration between the products we see an average of XX months for the old and an average of XX months for the current product. A remark which has to be made is that the lifetime of the current product is too short in order to reach the maximum duration. So the given summary will give some insight in the disability probabilities and the durations. To retrieve the realized recovery rates, a software program is written in SAS to filter the recovery rates.

First, all the claims are arranged att_0, at the moment of become disabled, all claims have been reported. The number of disabled at the beginning of year t are compared with the number of disabled at the end of year t, as displayed in formula 4.1.1. This is done till the maturity of the longest claim. This resulted in the recovery probabilities, from which the retention rates can be derived, as given in Appendix G: Realized recovery & retention rates. Caused by the small dataset the youngest and oldest age categories are grouped together and the rest of the ages are grouped by two. These rates are corrected with the mortality probabilities, as given in Appendix F: Mortality rates. Since the current product has a deferment period, the recovery in the first year, t_0, is not reprehensive because clients often notify their disability in a later stage. In Figure 7, the realized retention rates of two age categories are displayed, in comparison with external rates.

$$r(x,t) = 1 - \frac{(number\ of\ disabled\ end\ year\ t\ of\ age\ group\ x + number\ of\ deceased\ persons\ in\ year\ t\ of\ age\ group\ x)}{(number\ of\ disabled\ in\ year\ t\ of\ age\ group\ x)} \quad (4.1.1)$$

$$For\ t = for\ a\ specific\ year$$
$$x = for\ a\ specific\ age\ group$$
$$r(x,t) = recovery\ rates\ for\ age\ group\ x\ and\ year\ t$$

4.1.2 External disability data

Knowing that the internal recovery rates are based on a small dataset it is interesting to look at external data to ensure stability. As mentioned in chapter 3.3 the KAZO-model is useful for premium estimation, in order to come up with more recent mortality, incident rates and recovery rates the Verbondsmodel of 2006 is used. The rates are determined by het Verbond van Verzekeraars. Verbond van Verzekeraars, represents the interest of private insurance companies operating in the Netherlands. Approximately, 95% of the operating insurance companies are member of het Verbond. They deliver data information to the insurance companies' nationwide. Within the model of 2006, the mortality, morbidity and recovery rates for premium establishment are discussed. These rates will give more insights into the retention rates of disabled.

First, the mortality rates will be discussed. Internal data on mortality is not reprehensive therefore the mortality table determined by the Koninklijk Actuarieel Genootschap (AG) is used. In this research the mortality table GBM/GBV 1995-2000 is used, given in Appendix F: Mortality rates.

The morbidity rates give information about the disability in the first hand. On the second hand these rates give information to which category of disability. Four groups of disability can be distinguished.

- Fully Occupationally disabled (IVA), they are fully occupationally disabled and have a very small chance of recovery.
- Partially disabled (WGA), can be divided into 2 subcategories.
    - Partially disabled, between 35 - 80 % with a reasonable recovery chance.
    - Partially disabled, between 80 - 100% with a reasonable recovery chance.
- Disabled for less than 35 percent, this category is not relevant for the premium establishment because the payout starts only when a persons is for more than 35 percent disabled.

The morbidity rates are defined as;

$$
\begin{aligned}
&\boldsymbol{Morbidity\ rates}\\
&\boldsymbol{Partial\ disabled\ 35-80\ \%}\\
&\mathrm{x} \leq 20, \quad \mathrm{i(x)} = 5.289 * 10^{-4}\\
&\mathrm{x} > 20, \quad \mathrm{i(x)} = 1{,}709 * 10^{-3} - 2{,}096 * 10^{-4} * \mathrm{x} + 9{,}462 * 10^{-6} * x^2 - 9{,}987 * 10^{-8} * x^3 + 1{,}596 * 10^{-10} * x^4\\
&\boldsymbol{Partial\ disabled\ 80-100\ \%}\\
&\mathrm{x} \leq 20, \quad \mathrm{i(x)} = 0.685 * 6.398 * 10^{-4}\\
&\mathrm{x} > 20, \quad \mathrm{i(x)} = 0.685 * (-5.153 * 10^{-3} + 4.306 * 10^{-4} * \mathrm{x} - 7.334 * 10^{-6} * x^2 + 4.227 * 10^{-9} * x^3 - 5.068 * 10^{-10} * x^4)\\
&\boldsymbol{Fully\ Occupationally\ disabled}\\
&\mathrm{x} \leq 20, \quad \mathrm{i(x)} = 4.219 * 10^{-4}\\
&\mathrm{x} > 20, \quad \mathrm{i(x)} = -3.469 * 10^{-3} + 3.024 * 10^{-4} * x - 6.962 * 10^{-6} * x^2 + 7.848 * 10^{-8} * x^3
\end{aligned}
\qquad (4.1.2)
$$

$x = age\ of\ insured$
$i(x) = mortbidity\ rates\ for\ age\ group\ x$

The morbidity rates of het Verbond are defined with Dutch WIA, wet werk en inkomen naar arbeidsvermogen, these rates are useful after the second year of being disabled. The MPPI, starts paying after the first year of being disabled therefore a correction have to made. In the past in the Netherlands the WGA-law was used. Within this law the payments started after being disabled for a year. The WGA-model, identifies the same rates only with a start after the first year instead of the second as in case of the WIA-model. Therefore the morbidity rates of the first year of being disabled are taken into account, obtained from the WGA model. Furthermore, in order to realize one morbidity rate, the proportions between the three morbidity categories must be taken into account. Finally, to prevent that probabilities are included twice, a correction for the morbidity rates have to be made. As mentioned a person first can become unemployed and later on also disabled, but at a specific time a person cannot be both. To avoid double counting, a correction factor for every subcategory is added. Hence the morbidity rates are showed in Appendix H: Morbidity rates.

Finally, the recovery rates can be established. The definition of recovery rates is already defined in formula, 4.1.1. As result the general formulas as defined by the Verbond, with the aforementioned disability groups are given in 4.1.3. Within the realized rates no distinction between recovery groups is made. This is not relevant because zero or everything is paid. As assumed within the KAZO-model

recovery after the sixth year is equal to zero. By making use of the Verbond, 2006 the recovery rates are relevant after being disabled for 2 years, in order to define the recovery rates after the first year, again the WGA model is used. Furthermore, the ratios of recovery per disability group are taken into account. In Appendix I: Recovery & Retention– Verbondsmodel 2006, the recovery and retention rates per age-category, starting form year 1 are given.

Recovery rates

Partial disabled $\mathbf{35-80}$ %

$r_2(x) = 0.167 - 2.56 * 10^{-3} * (x-2)$
$r_3(x) = 0.218 - 2.54 * 10^{-3} * (x-3)$
$r_4(x) = 0.158 - 2.11 * 10^{-3} * (x-4)$
$r_5(x) = 0.128 - 1.67 * 10^{-3} * (x-5)$
$r_6(x) = 0.128 - 1.67 * 10^{-3} * (x-6)$

Partial disabled $\mathbf{80-100}$ %

$$r_2(x) = 1.796 * 10^{-1} + 2.686 * 10^{-3} * (x-2) - 2.600 * 10^{-4} * (x-2)^2 + 6.521 * 10^{-6} * (x-2)^3 - 5.935 * 10^{-8} * (x-2)^4$$
$$r_3(x) = 7.208 * 10^{-1} - 3.719 * 10^{-2} * (x-3) + 1.441 * 10^{-3} * (x-3)^2 - 2.488 * 10^{-5} * (x-3)^3 + 1.348 * 10^{-7} * (x-3)^4$$
$$r_4(x) = 7.914 * 10^{-1} - 5.870 * 10^{-2} * (x-4) + 2.637 * 10^{-3} * (x-4)^2 - 5.264 * 10^{-5} * (x-4)^3 + 3.553 * 10^{-7} * (x-4)^4$$
$$r_5(x) = 6.084 * 10^{-1} - 3.579 * 10^{-2} * (x-5) + 1.641 * 10^{-3} * (x-5)^2 - 3.634 * 10^{-5} * (x-5)^3 + 2.677 * 10^{-7} * (x-5)^4$$
$$r_6(x) = 6.970 * 10^{-1} - 3.211 * 10^{-2} * (x-6) + 1.370 * 10^{-3} * (x-6)^2 - 3.210 * 10^{-5} * (x-6)^3 + 2.484 * 10^{-7} * (x-6)^4 \quad (4.1.3)$$

Fully Occupationally disabled

$r_2(x) = r_3(x) = r_4(x) = r_5(x) = r_6(x) = 0$

$x = age\ of\ insured$
$d = state\ d, for\ 2, \dots, 6$
$r_d(x) = mortbidity\ rates\ for\ age\ group\ x, and\ the\ state\ d$

4.1.3 Comparing internal and external data

Having the retention rates based on internal as well as external data, both rates can be compared. First, the external is grouped in the same age categories as the internal data. Afterwards, per age category a graph with the current rates, the rates of the Verbondsmodel, the realized rates and the Verbondsmodel with correction factors (discussed below) is made. Consequently, nineteen different graphs are made within Figure 7, two of the mentioned graphs are shown. The retention rates for the persons aged 36&37 and 56&57 are given. As visible the realized rates are lower, than the current and the Verbondsmodel rates besides this it is also visible that the realized rates fluctuate heavily for some age-categories. This last effect is caused by the small size of the dataset.

As a result, correction factor for different age categories is calculated. The correction factors are retrieved by taking the average difference between het Verbondsmodel rates and the realized rates. This difference is distracted form the new Verbondsmodel to obtain the Verbondsmodel with corrections factors, next the Verbondsmodel with correction factors per age-category is created. Resulting, the model is less dependent of portfolio fluctuations and it shows more realistic rates for the MPPI of Achmea.

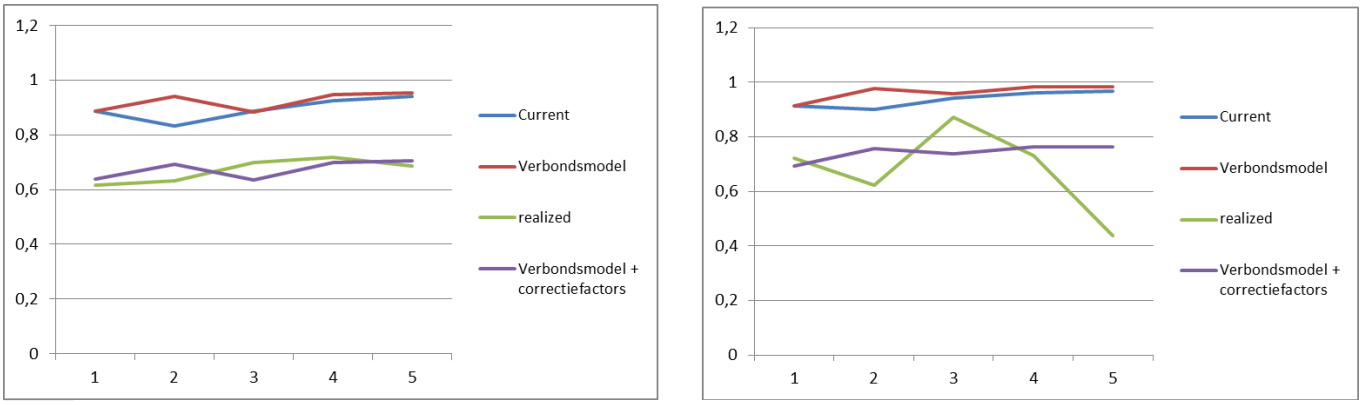

Figure 7: Retention rates for persons aged 36-37 (A) and aged 56-57(B)

After analyzing the nineteen different graphs with the retention rates of the four different possibilities some conclusions can be drawn. First, the realized data, is not large enough to arrange new retention rates resulting the data fluctuates too much. Another disadvantage is the small dataset. Whenever a portfolio shifts will happen there is a change that the current rates will not reflect reality.
Using the external data, both problems will be smaller by having a large and less dependent dataset. The too large probabilities are disadvantages of using the external datasets. This is confirmed by the graphs as well as the amount of profit Achmea has realized recent years. As a result, the Verbondsmodel with correction factors will be used.

In the MPPI premium model, the retention rates are transformed into a LX-table with survival opportunities, shown in Appendix J: Corrected retention rates & survival opportunities. This is done in accordance with the KAZO- model as described in paragraph 3.3. Having the mortality, morbidity and the survival opportunities gives the ability to check the effect on the premium. Furthermore a back test can be performed in order to check the accuracy of the model, this will be done in the paragraph 5.1 disability.

4.2 Unemployment data

After discussing the disability aspects also a discussion about unemployment, probabilities and duration will be described. As mentioned in chapter 2, the most important aspects for the premium level of the unemployment part are, the average unemployment duration and the probability of becoming unemployed. Where the disability probabilities are determined more into detail, for the unemployment part this is less necessary since the payout is short term. The payout starts immediately with a maximum of 12 months. Therefore a more simplistic version is used where the duration and unemployment probability is used for premium determination.
When launching the MPPI not enough internal data was available to establish internal unemployment probabilities. Therefore, national unemployment probabilities of the Netherlands where used. In order to fit them more to the portfolio probabilities of the current product an unemployment correction factor was added to the model. Performed by taking only 65% of the unemployment probabilities. Since then, one adjustment is made by updating the unemployment probabilities but a back-test to check whether the data predicts reality, is never done. In order to establish a realistic premium in accordance with the actual damage the unemployment probabilities have to match with the unemployment payout reality of the MPPI.

4.2.1 Unemployment probabilities

Before deciding which probabilities have to be used first, there have to be checked whether the realized unemployment probabilities of the portfolio correspond with the unemployment probabilities of the Netherlands. The unemployment rates are derived from the CBS, Centraal Bureau voor de Statistiek, table unemployment rate labor force. In this analysis, the data of the years 2006-2013 will be used and the probabilities within the different age categories; < 25, 25-34, 35-44, 45-54 and >55 will be discussed. Furthermore, the data of both products will be used in order to realize the age distributed evenly over the portfolio. In order to compare the data an assumption is made. In the documentation, Achmea stores the age when people become unemployed but not the number of policies per age category. In order to realize unemployment rates per age category the assumption that the past, current and future portfolio proportions within the different age categories will remain equal. An overview of portfolio proportions is given in Appendix C: Portfolio proportions.

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Some remarks before commenting on Table 4. For calculation of the unemployment rates of Achmea, the number of policies are used while it should be the number of insured persons. Therefore are the retrieved rates are bit higher than in reality since there are more insured persons than policies. In Table 4, the unemployment rates of 5 different age categories for the years 2006 till 2013 are displayed. In the last two columns the rates of the CBS and Achmea are weighted in line with the portfolio proportions as given in Appendix C: Portfolio proportions. In the last row the average percentages of unemployment are displayed whereby all years are weighted equally.

- According to Table 4, the unemployment probabilities of Achmea are much lower than the probabilities of the unemployment rates in de Netherlands. In all the 40 scenarios the rates of Achmea are lower than the rate of the CBS.
- In the Netherlands, the persons younger than 34 years are most likely to become unemployed while in the portfolio of Achmea this group is least likely to become unemployed.
- The second contradiction is, within the portfolio of Achmea persons above 45 years old are most likely to become unemployed while in the Netherlands they are least likely to become unemployed.

Within Figure 8, the unemployment rates are displayed in a graph whereby the two mentioned contractions are very clear to see. Furthermore a trend within the data of the CBS as well as in the data of Achmea is visible. Keep in mind that the axes of both graphs are different when comparing the graphs. The difference of CBS and Achmea can be partly explained by the difference within the two populations. Where the rates of the CBS are based on the whole labor force in the Netherlands, the population of Achmea consist only of homeowners with an MPPI. Having a mortgage asks for enough capital requirements and most often also an indefinite employment contract therefore the last group has an advantage looking at the unemployment probabilities.

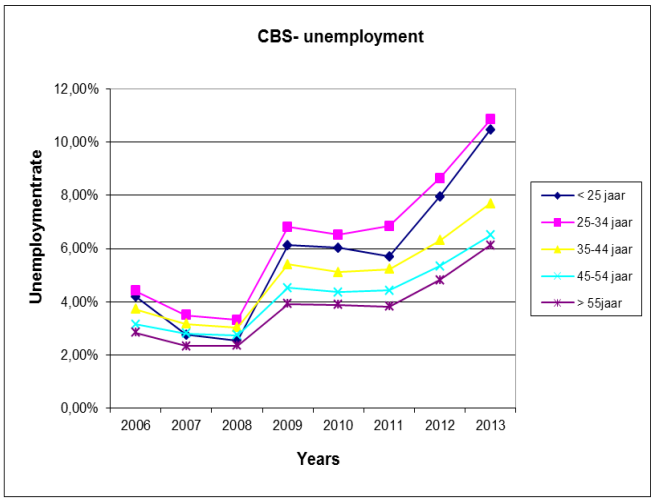

Figure 8: Unemployment rates CBS versus Achmea

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In order to realize a more realistic premium model new probabilities have to be implemented. First, a choice between internal or external data have to be made. The advantage of internal data, it is more realistic than external data but the disadvantage is the size of the dataset, which is in this case too small. In addition, external data can respond more accurate to portfolio shifts. Therefore the external dataset, retrieved from the CBS, Centraal Bureau voor de Statistiek, with correction factors will be used.

To compensate for the difference between CBS and Achmea a correction factor of 0.65 was used, according to differences in probabilities there can be concluded that this is not a realistic estimation. With help of the least squares method a new more realistic estimation is determined. The least squares method is a calculation method, given a set of points within a plane, a set of curves with the "best fit" is provided. The name, least squares method can be derived from the applied criterion for "best fit"; the best fitted are measured by the sum of the squared deviations. Having the data points of the internal data as well as of the CBS, the new proposed correction factor can be determined, a correction factor equal to 0.313 is retrieved. Within Figure 9, the yearly unemployment rates of the CBS, the weighted unemployment rates of the CBS(weighted with the current portfolio proportions), the realized rates of Achmea, the rates of the CBS with the current correction factor (0,65) and the rates of the CBS with the new correction factor (0,313) are given. As visible in Figure 9, the option CBS with a new correction factor will be the best estimation. Having one correction factor has the disadvantage that the two contradictions as mentioned earlier cannot be corrected. Therefore the last option, CBS data with 5 correction factors is also established. A correction factor for every age-category gives the opportunity to bring the probabilities of the CBS more in line with reality. Again the least square method is used to determine the more realistic correction factors. In Appendix K: Correction factors unemployment, the estimation of the correction factor for every age category is shown. The age-category dependent correction factors vary between 0.1450 and 0.6348.

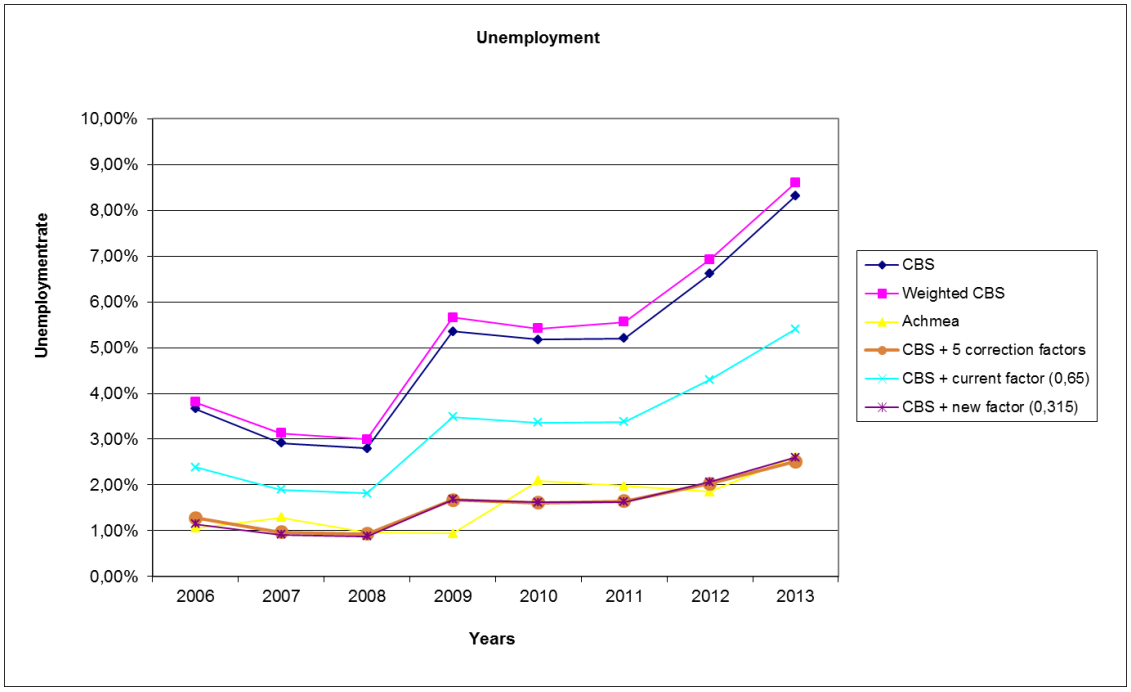

Figure 9: Unemployment rates; CBS, weighted CBS, Achmea, CBS + old factor and CBS + new factor

4.2.2 Unemployment payout duration

Besides the probability of becoming unemployed also the duration of a payout have to be clarified in order to establish a premium. When losing his/her job, the client is entitled to receive a benefit, the duration depends on the employment contract. Within Appendix M: Unemployment summary - Achmea; the duration of the payouts is displayed. The average amount of the closed claims for the

current product is XX months while for the ongoing claims this is XX months. This results in a total average of XX months for the current product.
Besides looking at internal data also external data, retrieved form the CBS, can be useful. The benefits of using data from the CBS is that it uses national data, which is less dependent for future portfolio changes such as age or occupational shifts.
The CBS process data, retrieved from the UWV (Uitvoeringsinstituut Werknemersverzekeringen), on unemployment durations. In reality the average duration unemployment in months will be higher than the registered months from the UWV. This is caused by the conditions of the UWV, if you are unemployed you get a benefit which depends on your work history. People with longer work experience receive a benefit for a longer period. Becoming unemployed and having a MPPI you get a number of months which does not depend on your work history. This results in different durations for Achmea and the UWV. In Appendix L: Unemployment duration - CBS; the yearly duration for the whole labor force, weighted duration according to the current portfolio proportions, the yearly duration per age category, the average duration per age category for the last eight years and the average duration for the whole labor force during the years 2006-2013 are displayed. In which the duration difference between the age categories is clearly reflected, from 3.4 for the youngest age category till 9.4 for the oldest age category.

As visible, on the first hand both datasets on itself are not useful. Therefore different scenarios are tested. First, per age-category a maximum duration for the old as well as for the current product. Furthermore, one duration for all the categories, a duration per age-category based on a combination of both products. And finally also the average durations of the CBS with different correction factors.

After observing all these different possibilities, some conclusions can be drawn. Looking at the durations of the both product it is visible that the duration of the payout depends on the age-category to which the insured belongs. Therefore implementing only one duration is not desired. Due to the recent changes in the product policy conditions of the old and current product, focusing on a duration estimated of both products is not realistic, for example in the past it was possible to protect yourself for 12 or 24 months while with the current product it is only possible to protect yourself for 12 months. Furthermore, focusing on the current product only is not realistic due to the short claim history of the product and the unequal distribution between the ages. As result, the data of the CBS with correction factors is taken into account. As mentioned, the durations of the CBS depend on the work history therefore is it needed that the younger age-categories are compensated more than the older age-categories. As result, two different weighting possibilities are tested, shown in Appendix L: Unemployment duration - CBS. Finally, the first scenario with a lower weighting, is chosen, since it reflects realty more correctly. Within the paragraph 5.3.2 back testing unemployment, a back test is performed in order to check whether the unemployment data fits to reality.

4.3 Other parameters

4.3.1 Fixed and variable costs

When closing an insurance, the insurer will make costs. These costs partly consist out of fixed costs closing the insurance and partly out of variable costs which increase with the a higher insured amount. The investigation of the costs establishment will be out of the scope of this research. The F&C department has recalculate the fixed and variable costs for an MPPI resulting in XX for the fixed costs. The variable costs for the disability part are XX for claim handling costs and XX for assessment costs depending on the insured amount. The variable costs for the unemployment part are XX for claim handling costs and XX for assessment costs depending on the insured amount.

4.3.2 Interest rate

Since 2009, the MPPI use one value, 3%, for the interest rate. This rate is contemporary unrealistic. In order to come up with a better rate the interest rate can be based on the Ultimate Forward Rate (UFR).

This rate UFR, is established by the European Central Bank, ECB. Observing these rates, the short term yield is around zero where the long term yield, with a maturity of 60 years, it is around 4.2%.
Deriving the new and more realistic rate is complex, different yield curves can be viewed and no unilateral "good" answer can be given. Below, a simplicity new interest rate is derived, and the effect of the new rate within the current model is shown.
Looking towards a MPPI, the payout period is partly short term, due to the unemployment part of the insurance. In contrast to the disability part, where the payout periods can vary between 4 and 20 years. As mentioned in 4.1, the average insured duration for disability is equal to 5 years. Looking at the UFR, for products with a maturity of 60 months, an interest rate of 0,10% is used. Within Appendix N: Interest rate., the old interest of 3 % is compared with the new interest rate of 0%, the effects of the interest rate changes in the current premium model is large. As visible, it is an important input variable. By the scope of the research this variable is not discussed into detail, within the coming chapters the premium effect with an interest rate of 3% and 0.1 % are compared. It is apparent that the interest rate will decrease to a value between 0 and 1 percent. Therefore the scenario with an interest rate of 0.1%, will be taken into account within the next chapters. This is a product transcending problem, further research is needed to estimate a new interest rate.

4.3.3 End date insurance policy

The MPPI stops when a client passes away, a client terminates the insurance, when the client has no longer a mortgage or when the retirement age is reached. Where in the past, in the Netherlands, this date was fixed at an age of 65 years nowadays this age is changed with tapings in between, into 67 years old. And it is likely that this age will change into the future therefore a retirement age variable have to be implemented, in order to calculate the right amount of premium for each client. Currently the premium of an MPPI is established at entrance for the entire insured period, what sometimes means till their retirement currently a premium till 65 years old is established but due to the changing retirement age the ending of the insurance can varied. When clients want to extent their insurance due to government decisions, changing of retirement age, this have to be possible. Before this can be incorporate into the model there have to be tested what the effects are. The changes for the retirement age is recently approved therefore no morbidity, recovery and unemployment rates for persons older than 65 are available therefore the assumption, that the rates of a person of 65 years can be used for the ages between 65 and the retirement age, is done. The mortality rates are update to the retirement age. Within Appendix O: Effects of retirement-age; the effect of the age change from 65 to 70 is displayed. First, the current premium model is changed in order to make the retirement age variable. Second, different scenarios are run whereby different variables are changed. From this we can derive that the change of the pension age has a small effect on the premium, whereby the monthly premium sometimes, increases, stay remain or decreases. Therefore, it is for clients possible to change the maturity of their insurance into their own retirement age. But client have to keep in mind when increasing the age also the years of paying a premium will increase in line.

4.3.4 Employed vs. self-contracted

During the last decade in the Netherlands more people became self-contracted instead of being employed and more employed people have a fixed contracts instead of having an indefinite contract. This trend is caused by the current changing environment. The data is reached from the CBS. The results are presented in Appendix P: Labor force – Employed vs. self-contracted. This change will influence the MPPI premium model in two ways. First, more people become self-contract being self-employed causes being assured for only the disability part because unemployment for self-contracted people in a MPPI is not possible. Second, more people have a fixed contract instead of an indefinite contract which have an influence on the unemployment payout period. When both trends continue in the portfolio less and lower unemployment claims can be expected.
Unfortunately, internal it is not possible to check this trend because the kind of employment contract is not registered. This is outside the scope of this research, further research can be interesting. The changes of becoming disabled differ between self-employed and employed people. Due to the current

portfolio distribution, 98% employed vs. 2% self-employed therefore in this research only the employed probabilities are discussed.

4.3.5 Prudence

Within the current model, two prudence variables are taken into account, these variables are added to ensure enough capital is reserved, beside the estimation an extra percentage was added, the prudence. Within the current model a prudence of XX% for disability and XX% for unemployment is added. Nowadays this is outdated, when the premium is established as best estimated the prudence is not desired. When estimating the premium as best estimated, there is enough premium to cover the damage and the other associated costs.
Currently, after deriving the net premium, the prudence is submitted afterwards other costs and term additions are added. Within Appendix Q: Prudence effect is displayed. The disability and the unemployment prudence effects are checked separately. Within Table 1 and 3 the scenarios are explained. Within Table 2 and 4 the effects are displayed. Omitting the disability prudence the premium will decrease within a range of 3.10 %-8.78%, when comparing the current probabilities with the current probabilities without prudence. After omitting the unemployment prudence, a decrease within a range of 7.8% -11.2% is visible, again tested for the current model with and without prudence. Resulting, the premium income will decrease by omitting the prudence which is necessary according to Solvency II. To ensure enough premium received the premium without prudence, has to be established as best estimate.

4.4 Conclusions

After finalizing this chapter some conclusions can be drawn. Comparing the internal realized recovery probabilities with the external probabilities, the Verbondsmodel 2006. The internal model is based on a small dataset and therefore not able to register portfolio switches correctly. Therefore the Verbondsmodel, 2006, is introduced. In order to make the external data more realistic correction factors are implemented. The Verbondsmodel with correction factors is used for the recovery and morbidity rates. The mortality rates are based on the GBM 1995-2000 mortality-table as defined by Koninklijk Actuarieel Genootschap.
For the unemployment part again a comparison between the internal and external data is performed. To fit the nation-wide unemployment probabilities to the MPPI probabilities age-dependent correction factors are introduced. As result the contradiction between the realized and the Dutch probabilities is solved. For the unemployment durations again external data is used. Within the external dataset, the payout depends on the work history therefore some adjustments are made before using these durations.
Furthermore, the costs, interest rate, retirement age, kind of employment contract and prudence are discussed. The costs, fixed as well as variable costs will decrease. The interest rate will also decrease but further research should determine to which value. Through the law chances, the retirement age will increase with steps therefore a variable has to be implemented. The employment contract difference and the prudence removal are deliberated as well. Resulting, many parameters and foundations are adjusted, this revision was necessary.

Chapter 5: Pricing model

The described model in 3.3 is implemented into an excel-model in order to calculate the premium for a specific case. In the file, different tabs are introduced in order to give a structured view of the premium establishment. The explanation of the premium model is given in Appendix R: Explanation premium model. Having the new estimated probabilities for disability unemployment the testing phase can start. First, the new premium effects are examined, this is done by implementing the new probabilities within the current model. When these aspects fulfill the expectations the probabilities are implemented within the current premium model. Having the new monthly premium a back test can be performed. These two step testing phase is executed for the disability and unemployment probabilities separately. Afterwards the overall premium effects are discussed.

5.1 Disability

5.1.1 Premium effects disability

First, the premium effects of the disability are considered. To test the premium difference, different scenarios are taken into account. The scenarios differ in insured duration, 20, 5 or 2 years, insured amount, 2500 or 500 euros and in start- and ending age, 20-65 years, 20-40 years or 40-65 years. Resulting 18 different premiums can be established for one set of probabilities. This is done for four different sets of probabilities, the same set as discussed in 4.1. So the monthly premiums are calculated for:

- Current; the probabilities as used in the current premium model
- New; the premium is established with probabilities of the Verbondsmodel 2006
- Realized; the realized disability probabilities of the MPPI
- New + correction; the probabilities derived from the Verbondsmodel with the correction factors as determined in 4.1.

Visible in Appendix S: Premium effects- disability part, Table 2 and 3, the 72 different premiums and the associated premium effects are displayed. With use of these premiums the premium effects can be measured. As visible, in Table 4, the premium with the new Verbonds-probabilities would increase compared to the current probabilities, which is an unintended effect due to the high profits of the recent years. As visible, in Table 5, the realized premium in comparison with the current premium, decreases with a range of 8.8 % till 55.1%, depending on the insured amount, duration and starting age. The effect of the proposed probabilities in 4.1, new + correction, is also clearly visible. The premium will decrease with a range of 9.3% till 54.4 % also depending on the insured amount, duration and starting age. Lastly, the difference in premium for the realized and new + correction are compared in Table 7, whereby in some cases premium increase and in some cases the premium decrease. So the achieved effect is obtained, a lower more realistic premium but dependent on a large national dataset.

5.1.2 Back testing disability

After analyzing the premium effects the new annual disability damage can be predicted. With help of the new mortality probabilities, morbidity probabilities and recovery probabilities with the associated correction factors, the survival probabilities per age-category can be derived. Knowing the number of insured persons per age categories gives the opportunity to derive the number of disabled people per age category, for a particular duration. Having the average insured amount gives the opportunity to calculate the expected amount of damage per age-category. Knowing the average duration per age-category, as a result the yearly damage for all the age-categories together can be given. This result can be compared with the damages over the last years, when this will be approximately equal the model can be approved.

Appendix T: Results back test disability, the above mentioned steps are displayed. Within Table 1, 2 and 3 the product characteristics for respectively, the old product, the current product and a combination of both products are given. Showing the number of insured persons, the duration and the insured amount per age-category. Within Table 4, the morbidity probabilities and survival opportunities for 5

years for the age-categories are given. In Table 5, the number of disabled per category with respect to the number of insured people, of both products. Resulting within Table 6, 7 and 8 the yearly damage is given. Depending on the product, old or current the insured amount and durations per age category vary. Therefore the expected damage with averages of the old product, current product and a combination of both products is given in Appendix T: Results back test disability. Depending on which duration is taken into account, the amount of damage varies, between € XXXXX million for the old product and € XXXXX million for the current product. The combination of both products results in € XXXXX million, also given in Table 5 below. Due to the current portfolio distribution, a combination between the old and current product would be the best estimation. Comparing € XXXXX million with the average amount of damages in the years 2007 - 2012, € XXXXX million, the proposed model with the associated probabilities gives a good estimation, 105%. Passing time, the proposed average durations and the average insured amounts have to be changed in order to give correct estimations, based on the portfolio distribution.

Confidential

5.2 Unemployment

5.2.1 Premium effects unemployment

In order to comment the premium effects, different scenarios are the viewed. The scenarios vary in insured amount 2500 or 500 euro and the insured disability period, 4 or 5 years. Furthermore, the unemployment period is equal to 12 months as visible within Table 1 in Appendix U: Premium effects – unemployment part. Due to the changes in the correction factor, durations and probabilities, different possibilities are tested.

First, the effect of introducing the age-dependent correction factors instead of one correction factor is viewed within Table 2 of the appendix. In paragraph 4.2, a contradiction within the unemployment probabilities between the CBS and Achmea, was visible therefore an age-dependent correction factor is introduced. For all different age-categories a decrease in premium can be expected caused by the lower correction factor values. For younger age-categories the decrease will be more than for the older age-categories. In Table 3, the correction factor, the new probabilities and the new durations are implemented; the effect is again clearly visible. Where in Table 2 a decrease between 24.1 and 38.8%, is visible now a decrease between 5.9% and 47.0% is visible. Consequently, the premium has become more age dependent, therefore younger ages benefit more of implementing the new input variables than the older ages. This difference is cause by contradiction between the data of the CBS and Achmea. In order to give more realistic predictions for the MPPI portfolio, different correction factors and longer durations are implemented as discussed in paragraph 4.2.

5.2.2 Back testing unemployment

After analyzing the premium effects again a back test is performed, to check whether the new probabilities predict the yearly damage. In order to predict the damage, the probabilities with correction factors, the insured amounts, the number of insured people and the durations as mentioned in 4.2 are needed. In Appendix V: Results back test unemployment, this data is presented. To check whether the new estimated damage predicts the recent years correctly, the realized damage of the years 2009-2012 is taken into account. Due to policy conditions and the processing of the current claims it is not realistic

to look back further or more ahead. Within Table 1, the product features of the current product, the probabilities with correction factors and the realized and the estimated damages are given per age-category. Table 2, is the same as Table 1 only this time for the old product. The following two comments can be made.

- As showed, the current product is undervalued; this is caused by using the current portfolio spread. In the past some of the old product users changed their insurance therefore they are transferred to the current product resulting more insured people in the current product, while in the past they belong to the old product.
- How many insured belong to a certain age-category yearly is not saved in the system. Consequently the current spread is used to estimate the damages. This results in an underestimated for the current product and an overestimated the old product.

Consequently, evaluating the products separately is not an option therefore a combination of both products is used to estimate the damage, as shown in Table 3 of the appendix. A difference between the insured amount for unemployment and the insured amount of the unemployment claims is visible in Table 4. For both products and for all the 5 age-groups, the average insured amount of the unemployment claims is higher than the average insured amount of all the insured. This is an interesting difference which has to be taken into account. Therefore, the average insured amount of the claims relative to the portfolio proportion is used.
Displayed in Table 6 below, a realized damaged of € XXXXX for the years 2009-2012 can be noted. Comparing this with the expected result, € XXXXX a good estimation is made. Still some of the categories are a bit under or overestimated this can be explained by using the current portfolio spread and not the yearly spread.

Age categories		Estimated/Realized
>25	Confident	87,2%
25-34		85,6%
35-44		117,5%
45-54		80,8%
>55		124,1%
Total		100,6%

Table 6: Back testing unemployment

5.3 Effects proposed premium model

In response of the new probabilities and the adjustments to the model, checks are performed. Whereby the result varies, sometimes an increase but often a decrease in the premium is the result. Within the premium tests there is determined whether the acquired results are realistic. For the adjustments there is tested whether the new adding's are implemented in correct way. Within this paragraph all the mentioned results are implemented and the premium effects are evaluated.

Within paragraph 4.3.2, the results of the interest rate are discussed, as visible these changes have an enormous influence. Looking at the importance for Achmea a choice for a certain rate cannot be made. As mentioned it is clear that the rate should be reduced but the desired result is difficult to determine and will be out of the scope of this research, therefore the premium results are shown with 3% interest rate as well as with 0.1%. In Appendix W: Effects current vs new premium model, are discussed. In the appendix three different possibilities are compared. In the first possibility, the premium of the current product is compared with the premium of the new product, the premium is calculated with an interest rate equal to 3%, furthermore the insured amount and the duration varies. In the three different possibilities, six different scenarios are determined, scenario 1-3 for 2500 euros and 4-6 for 500 euros within these scenarios the duration varies, 20, 5 or 2 years, as visible in Table 1 in Appendix W. In Table

2 and 3 the new premiums are calculated, for insurance with and without an unemployment protection. Within Table 7, below the results are displayed.

	scenario 1 - 20 years		scenario 2 - 5 years		scenario 3 – 2 years		scenario 4- 20 years		scenario 5-5 years		scenario 6- 2 years	
Unemployment protection	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
20-65	-46,8%	-37,8%	-41,0%	-14,2%	-41,0%	3,8%	-45,1%	-36,2%	-39,1%	-17,3%	-38,9%	-7,8%
20-40	-52,8%	-4,5%	-53,3%	-2,7%	-55,0%	6,3%	-50,4%	-9,1%	-49,9%	-10,9%	-51,0%	-7,2%
40-65	-44,1%	-45,4%	-23,9%	-15,9%	-17,0%	7,2%	-42,9%	-43,5%	-24,0%	-18,1%	-18,1%	-4,5%

Table 7: Premium effect, current vs new premium with 3% interest rate

As shown, the premium will decrease for all the scenarios except for scenario 3, without unemployment protection. As result, due to the increase of the morbidity rates, a small premium increase for the insurance in scenario 3 without unemployment is shown. Resulting the adjustments for unemployment part will be higher than for disability part of the insurance therefore a greater decline for the insurances with an unemployment protection is visible. The premium has become more age dependent whereby younger age-categories benefit more that older age-categories. Furthermore, longer durations have also more declines caused by the new implemented recovery rates.

In the appendix the same tables for the second possibility, can be found. In the second possibility the interest rate is equal to 0.1 %. In Table 8 below these effects are visible. Due to a lower interest rate the premium will be higher but this applies on both products, the current as well as the new. Still by the lower mortality rates, unemployment probabilities, costs and no prudence in most cases a decrease in the premium is visible. Except for the items whereby the increase in the morbidity rates, have too much influence, this is the case for short durations and for the younger age-categories.

	scenario 1 - 20 years		scenario 2 - 5 years		scenario 3 – 2 years		scenario 4- 20 years		scenario 5-5 years		scenario 6- 2 years	
Unemployment protection	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
20-65	-47,2%	-52,5%	-35,2%	-15,7%	-33,0%	5,5%	-45,1%	-36,2%	-39,1%	-17,3%	-38,9%	-7,8%
20-40	-48,9%	23,0%	-51,0%	0,0%	-52,6%	9,5%	-50,4%	-9,1%	-49,9%	-10,9%	-51,0%	-7,2%
40-65	-48,4%	-50,5%	-23,7%	-17,8%	-15,0%	7,9%	-42,9%	-43,5%	-24,0%	-18,1%	-18,1%	-4,5%

Table 8: Premium effect, current vs. new premium with 0.1% interest rate

After evaluating the effects of the premium with 3% interest rate as well as with 0.1% interest rate, also a combination has to be evaluated. Within paragraph 4.3.2, the interest rate changes are discussed. A well-established new interest rate cannot be given but it is certain that the interest rate will decrease to a value between 0 and 1 percent. Therefore also the current premium with an interest rate of 3% is compared with the new premium with an interest rate of 0.1%, visible in possibility 3 in Appendix W. In the appendix again the same table layout is used. The result is also given in Table 9, a decrease in premium for insurances with an unemployment protection is visible. For the insurances without an unemployment correction, the premium often increases. Having lower interest rates results in higher premiums for the insured. In the two possibilities as mentioned above for some cases the morbidity rates increase more than the decrease in mortality and survival probabilities. A decrease in the interest rate causes a more fluctuating premium for shorter durations the premium will increase more.

	scenario 1 - 20 years		scenario 2 - 5 years		scenario 3 – 2 years		scenario 4- 20 years		scenario 5-5 years		scenario 6- 2 years	
Unemployment protection	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
20-65	-34,1%	-32,8%	-30,3%	3,8%	-31,4%	22,4%	-33,4%	-21,8%	-29,7%	-4,3%	-30,5%	3,2%
20-40	-42,4%	48,7%	-49,2%	9,0%	-51,9%	15,6%	-40,9%	13,6%	-46,3%	-3,6%	-48,3%	-2,2%
40-65	-38,2%	-38,2%	-18,4%	-9,4%	-11,7%	14,5%	-37,4%	-37,0%	-19,1%	-12,6%	-9,5%	0,4%

Table 9: Premium effect, current premium with 3% interest rate vs new premium with 0.1% interest rate

Previously the premium effects for a single premium are discussed, to show the difference in premium revenues for Achmea, Table 10 provides more insight. Time will tell, for whom this premium is applicable. When the premium is launched for new clients only, the new premium effect in revenue, the coming years, is hardly visible due to the current clients with their earlier established premium.
Therefore an estimation is made, taking into account the current portfolio distribution with the average, insured amount for disability and unemployment, age, duration and maturity of an insurance. The premium revenues with the current and the new premium are estimated.

Age categories		Difference
>25	Confide	-36,9%
25-34		-27,9%
35-44		-17,9%
45-54		-18,8%
>55		-12,5%
Total		-21,4%

Table 10: Premium revenue effects

As result, the overall premium revenues will decrease with 21.41%. For the younger ages the premium revenues will decrease more than for the older ages, this is caused by the more age dependent premium as mentioned before. A remarks which have to be made is, the current portfolio distributions with averages (durations, insured amounts etc.) are used therefore table 10 gives only a rough estimation.

5.4 Conclusions

The new defined and established parameters and foundations are proposed. These have to be implemented in order to register the premium effect. First the disability and unemployment adjustment will be reviewed separately afterwards the total implementation is discussed. After implementing the new disability probabilities the premium will decrease between 9.3% and 54.4%. Depending on the duration, insured amount and age the premium decreases more or less. The disability probabilities estimate the annual amount of payouts of the last years correctly.
For unemployment the premium decrease is between 5.7% and the 47%. Also the new unemployment probabilities predict the last years overall correctly. A remark which have to be made; the average insured amount is smaller than the average insured amount of the payouts. Further research is necessary to explain this difference. Finally all the foundations and parameters are implement and reviewed with an interest rate equal to 3% and 0.1%. The premium can drop to a maximum of 55% depending on the chosen; unemployment protection, insured amount, insured duration, age and interest rate. The premium has become more age dependent whereby younger age-categories benefit more that older age-categories. By the new lower recovery rates the longer durations benefit more than short ones. Looking at the policy with unemployment protection also a greater decline is visible. Last, the interest rate has a noticeable effect on the premium determination further research is needed to retrieved a new interest rate. Resulting, the current premium model with the interest rate of 3% is compared with the revised premium model with an interest rate of 0.1%. In 27 of the 36 scenarios the premium deceases. With a rough estimation the premium revenues of Achmea will decrease between 36.9% and 12.50%. Overall a decrease of 21.4% is visible.

Chapter 6: Disability provisions

Within the current MPPI there are provisions for the disability part as well as for the unemployment part. Focusing at the unemployed part, these claims are mainly short term, with a maximum of 1 year therefore there will be hardly any difference between the best estimate and the current method. The provisions for the disability part are longer, up to 20 years. These provisions are therefore more interesting to investigate. In this research the unemployment provisions will be out of the scope.

Presently, the provisions for disability are settled as the potential maximum damage. Becoming disabled the monthly payment for the insured time period is reserved. According to the Solvency II manual, the premium and the provisions have to be settled as the best estimated. Using the best estimate the provisions should be enough, to ensure for worst case scenarios, the capital requirements are there to accommodate this. In order to estimate the difference between de current en best estimate methods, first the current provision method will be discussed; afterwards the best estimates will be retrieved with help of the earlier derived disability probabilities. Finally the retrieved difference will be discussed.

6.1 Current method

In order to ensure, enough money is reserved to pay the registered disability claims, the disability provisions are estimated as maximum. The disability claims are registered yearly. For a new claim, the monthly insured amount and the insured time-period are needed to derive the maximum provision. Knowing the deferment period of the insured, the starting and ending date (maturity of the insured time) can be established. The actual provisions for a claim can be derived, passing time the provision will decrease in value. Hereafter the yearly provisions for the old as well as for the current product are defined. Following-on, the overall provisions can be determined.
Within the current method the recovery or mortality probabilities are not taken into account, this is the main drawback. As mentioned earlier, the recovery rate from all the incoming disability claims is above 50%. Besides the recovery rates also the mortality rates have to be taken into account for predicting the provisions. Resulting, it is evidently that reserving at maxim is not realistic.

6.2 Best estimate method

The purpose of the best estimate is to come up with a more realistic method, to define the provisions. Within chapter 4 a choice toward the Verbondsmodel with correction factors is given. The associated mortality, recovery and the retention probabilities are defined and can be used for provisions determination as well. Besides these probabilities also the insured time period have to be taken into account. Resulting, the retention rates for the insured time period, up to 20 years, for a given disability age can be derived, given in Appendix X: Retention rates up to 20 years. As observable, within the first five years the recovery probabilities are taken into account but after the fifth year the recovery rates are set equal to zero, as assumed within the KAZO-model. Only the mortality rates influence the last years. Depending on the insured time period; 4, 8, 12, 16, or 20 years the duration can be determined, as a result the durations varies, given in Appendix Y: Disability durations. Having the best estimated durations, the implementation into the current provision model can start. The insured time period, the disability age and the number of years being disabled are needed to derive the number of disabled months with as maximum the number of insured month, the starting and ending date and finally the provision itself. The model is still up to date; the provisions can be given at a specific moment group by the year of becoming disabled.

6.3 Comparison between current and best estimate

Deriving the provisions with both methods the provisions can be compared. The provisions are derived for the old product as well as for the current product. As visible the level of the provisions for the new product decreases more than for the old product. Cause by the durations, for the old product a maximum of 4 years is insured while for the new product the minimum is 4 years. After reviewing the differences, shown in Table 11, three conclusions can be drawn.

- Switching from the current method to the best estimate method, the provisions will decrease with 16.6% for the current product and 4.8 % for the old product. Resulting, the average provisions for the MPPI decrease with 14.2%.
- Depending on the durations of the insurance the provisions will decrease more or less. For longer durations, the overall provisions will decrease more. The effect is caused by the recovery and mortality probabilities. Until the fifth year recovery is taken into account, which results in lower overall durations. For longer durations, the probability of passing away is higher consequently the mortality probabilities also influence the durations
- As noticeable, for recent years the decrease in provisions is higher than for older years. Again the recovery rates are the reason. In the beginning, disabled have more changes to recover. The probability for maximum payout is lower in the beginning than at the close to the maturity of the insurance, where the recovery rates are equal to zero

	Old product	Current product
2007	0,0%	0,0%
2008	0,0%	0,0%
2009	0,0%	-6,5%
2010	0,0%	-9,5%
2011	-1,4%	-11,3%
2012	-6,5%	-22,9%
Total	-4,8%	-16,6%

Table 11: difference in provisions

6.4 Conclusions

The provisions are made to ensure that the registered claims can be paid. Currently, the maximum payout is reserved as a provision but due to the Solvency II regulations this is not the best estimate. Consequently, the retrieved recovery and mortality probabilities are implemented in the current provision model. A decrease in the provisions is noticeable. Depending on the insured time, disability duration and the age the probabilities differ. Sequential, for recent disabled and longer disability durations the provisions decrease more cause by the higher recovery probabilities in the beginning. In the newer years the provisions for the current product can decrease with 23%, when using the best estimate instead of the current method. The provision revision for the MPPI is relevant.

Chapter 7: Risk capital

Within chapter three the most important risks of the MPPI product which are division-wide calculated are discussed. These risks are counterparty default risk, catastrophe risk, expense risk, operational risk, premium risk and reserve risk. Whereby the last two risks are the most important ones, by the magnitude. In this chapter premium and reserve risk will be the focus. First the life or non-life choice is explained. Afterwards the current method is explained and the different methods are discussed. Finally, the recommendations for the risk capital calculations are discussed.

7.1 Life/Non-life distinction

As mentioned in chapter three, risks can be calculated with the life or non-life method depending on the kind of insurance. Before estimating the risk capital, a choice toward the life or non-life method is needed to arrange the insurance in a group. Afterwards, the risk capital can be calculated with the corresponding standard model. Normally, this is an easy choice, but caused by the two aspects in the MPPI, disability and unemployment, the choice is difficult. When it would be a major insurance for Achmea a distinction would be the best option. Nowadays, with a risk capital of € XXXX million it is marginal compared with the € 20.233 million of gross written income. Therefore a split is not an option, for Achmea. So a choice between life and non-life has to be made.
Observing the annual amount of pay-outs, approximately 2/3 of the amount is paid for disability claims and 1/3 for unemployment claims. Looking at the current product since 2006, XXX disability-claims are reported whereof 49.1% have been paid while for unemployment XXX claims are registered whereof 69.7% have been paid. An additional comment, everyone is ensured for disability, for unemployment this is a choice. As stated before the disability duration is longer than the duration for unemployment which is short term. Resulting there can be concluded that the probability of becoming unemployed is much higher than becoming disabled but whenever becoming disabled the payout duration will be higher. This aspect confirms the life, non-life distinction.

First, the MPPI is viewed can be modelled as a life insurance product. Comparing the disability part of the MPPI with a life insurance as disability insurance for self-employed, AOV, the durations and the insured amount are much higher than for the MPPI. The disability probabilities for both insurances are equal. With an MPPI, the average insured time for disability is 5 years, so in many cases a temporary solution. Focussing on the disability insurance for self-employed the maturity of the insurance is most often till retirement age, so the whole period between becoming disabled and retirement is covered. Additionally, also the insured amount for the MPPI is much small. Observing the unemployment part, no similarities can be found, the unemployment probabilities are higher than the disability probabilities while the duration is shorter.
Second, the MPPI is viewed as non-life product. Comparing the MPPI, more similarities can be found. The non-life insurance, absenteeism caused by illness or disability normally covers a two year payout period. When an employee becomes disabled the loan will be paid and the employer is assisted with the reintegration path. The payout period is similar to the unemployment part of the MPPI, the payout starts quickly after the event. Also some similarities with the disability part of the MPPI can be found, the payout is restricted to a given time period and the payout can start immediately, by setting the deferment period to 0.

As visible the disability part of the MPPI, is a life-insurance comparing it with other disability insurances. But comparing it with other important life-insurances, life-insurance, it is minuscule furthermore it has some similarities with the non-life part while for the unemployment part only non-life aspects can be recognized. Resulting, due to the size and characteristics of the product, the risks of the MPPI can be approached best with the non-life method for risk capital determination.

7.2 Current method

Currently, within Achmea they are establishing internal models for the most important risk types and thereby the biggest portfolios. For smaller insurances such as the MPPI there are other alternatives, like scaling with a larger insurance portfolio or applying the standard model. Due to the mixed characteristics, disability and unemployment, of the MPPI, scaling is not possible therefore the standard model is used. And as explained in 7.1 the non-life method is used.

7.3 Methods for risk identification

So in order to calculate the risk capital according to the Solvency II manual three different models can be distinct; standard formula, internal model or undertaking specific parameters. Furthermore, scaling can be applied.

- Standard formula, SF; within the new Solvency II regulations it is necessary to calculate the risks capital an insurance product has to hold aside, in order to cover up the risks the insurance product is facing. Within the solvency II manual, formulas for life as well as non-life insurances for specific products are given, called the standard model.
- Internal model, IM; A model to estimate the risk capital. An insurance company can choose to developed an own model based on own portfolio data, which gives a better fit of its risk profile. Before implementing the internal model the Dutch Central Bank has to approve it.
- Undertaking Specific Parameters, USP, use the standard model but with some adjusted parameters. For example the given σ, can be adjust in order to give a more accurate estimation. These adjustments also have to be approved by the Dutch Central Bank.
- Scaling is done on the basis of similarities in the products. Having a product with the same characteristics as another product scaling can be used. Normally smaller insurances are scaled on larger once.

Besides scaling, the internal model or undertaking specific parameters the insurance company is obligated to deliver the risk capital with the standard formula. This is required for overall comparisons between insurance companies and also for the internal check, whether the own model is equal to the standard model. On the first hand, taking the standard model may seem the best and easiest option but using the standard model has disadvantages. The standard formulas as given in the Solvency II manual are general. They can be applied in all the countries in Europe and should apply on all the insurance companies. To deliver the standard formula data from all over Europe is used. But the data quality is not well checked and the season effects are not taken into account. So the major disadvantage of using the standard model is immediately clear, come up with a general formula with a certain σ for a particular product is not the best estimate of the risks a specific insurance product is facing.

7.3.1 Reserve risk

The risk capital consist mainly of premium risk and reserve risk, therefore it is interesting to come up with improvements for both risks. The definition of reserve risk as in the solvency II manual: *The risk that the benefits and the claims handling of outstanding damage of older accident years are higher than expected.* (Achmea ppt 2014). The capital is reserved in order to cover the possible losses for the ongoing claims within the next 12 months. When a client, registers a claim, the payout period starts after the deferment period. The provisions are based on the amount and the duration of the claims. Whereby the duration depends on the insured period and the recovery probabilities when having a disability-claim or the probability of having a new job when having an unemployment-claim. So the reserve risk has to cover up when the provisions are not enough. As observable the 12 months horizon, is a “short- term” risk.
Currently, the reserve risk of the MPPI is determined with the standard non-life method. In order to estimate the reserve risk with internal models, which is preferred, they have to be calculated quantitatively. In order to make use of internal models, the model must be tested, with a trial to check

whether the results are significant. The results should extrapolate the payments pattern for the MPPI in a correct way.
Due to the scope of this research no in-depth reserve risk study is performed. An interesting point for further research is to check first whether the data meets the requirements, second whether the trial can be performed and finally what the results mean. Resulting, a choice about the approval of the internal model can be made.
In order to show the effects of the new best estimated premium and provisions the reserve risk capital is calculated with the non-life standard model, formula 7.3.1.

$$Reserve\ risk = 3 * \sigma * V$$

$$For\ \sigma = standard\ deviation\ for\ income\ protection\ insurance \qquad (7.3.1)$$
$$V = the\ volume\ of\ the\ provisions$$

In order to determine the risk capital the best estimated provisions are needed. Within this research only the disability provisions are determined. As result, only the risk capital for the disability provisions is calculated. The current and new disability provisions are determined in paragraph 6.3 and can be used as input parameter. The σ, standard deviation, can be retrieved in the Solvency II manual. For a non-life income protection insurance the σ is equal to 0,14. Having all the variable the disability reserve risk, of the current provisions and the best estimated provisions can be calculated. As result, the disability reserve risk can decrease with 14,2%. Even though the standard model is used, the effects of the best estimated premium and provisions are already visible. As result, updating the insurance with respect to Solvency II has besides the regulation also premium, provisions and risk capital benefits.

7.3.2 Premium risk

The premium risk measures the uncertainty of the cost of claims and the expenses. The claims are based on the amount and timing of claims and expenses that will arise during the coming year, within a 12 months horizon. Determining the risk premium two risks are identified: the claim risk premium and the risk premium costs both aggregated to the premium risk. So the risk of having enough premium in the coming 12 months in order to fulfil the claim requests of the client during the next 12 months' time horizon.
Currently, the risk is calculated with the standard non-life model for income protection insurances. The switch towards an internal model for premium of the MPPI is not possible due to the recent launch of the product. Due to the characteristic in different durations the old product cannot be used in evaluating the premium risk. In 2009, the last product changes are implemented, whereby the payout duration is increased to 20 year, in order to establish a well based internal model, the data should meet this maturity. Since the most chosen duration is 4 years, the average duration of the insurance is equal to 5 years therefore after 5 years of claim registration there can be checked with a trial whether the dataset is well enough to establish in internal model. Furthermore, the age spread within the current product is not realistic, over time the age-spread has to become more equally. Resulting currently it is not possible to use an internal model for the premium risk, within 4-5 years a trial can be relevant to check whether the dataset is realistic and big enough to use. Looking at the partial internal model is also not relevant caused by the data. Therefore for now the only possibility will be the standard model.
To show the effects of the premium and provisions adjustments the premium risk capital is calculated with the standard non-life model to illustrate the capital effects. In chapter 5.3 the overall effects for the premium revenues for Achmea is roughly estimated. As result the overall premium will decrease with 21.4%. For the premium risk capital estimation the following formula, 7.3.2 is used.

$$Premium\ risk = 3 * \sigma * V$$

$$For\ \sigma = standard\ deviation\ for\ income\ protection\ insurance$$
$$V = the\ volume\ of\ the\ premium$$

(7.3.2)

Again the σ, the standard deviation, can be retrieved in the Solvency II manual. The σ, for premium risk for an income protection insurance is equal to 0,09. The V is equal to the premium revenues, which decrease with 21.4% for the new premium model. Using the current premium model a premium risk capital of € XXXXX have to be reserved. This premium risk capital is in line with the premium risk capital as given in section 3.2. When using the new premium only a risk capital of € XXXXX have to be reserved. As result also the premium risk capital will decrease with 21.4%.

7.4 Conclusions

After the made adjustment in the premium and provision determination it is time for risk capital determination. Currently, there are four different possibilities to give the capital requirement, standard model, internal model, undertaking specific parameters and scaling. Establishing the risk capital with one of the last three possibilities, the standard model have to be derived as well, in order to compare the companies overall.

Internal models are preferred because this model takes only the risks which are relevant for the MPPI of Achmea into account. As defined in chapter 3, the premium and reserve risk are the most important ones due to the size. Currently, these risks are defined with the standard non-life method. In order to switch toward the internal model the data history has to be long enough and realistic. For reserve risk this has to be tested with a trial. Resulting for reserve risk further research is needed to give a definite conclusion, for premium risk the data have to be reviewed in five years; currently the data history is too short to give a fair view. Caused by the lower premium en the decrease in provisions also the risk capital, as determined with the standard model will decrease.

As result, updating the insurance with respect to Solvency II has besides the regulation also premium, provisions and risk capital benefits.

Chapter 8: Conclusions

The main goal of this research was to answer the central research question as given in 1.3.1. Below this question is given again.

What is the (financial) impact of revising the parameters and foundations for the product Mortgage Payment Protection Insurance (MPPI) respecting Solvency II requirements?

The first step that was taken to answer the foregoing question, was to retrieve the Solvency requirements for the (Mortgage) Payment Protection Insurances. The goal of Solvency II, is to establish an insurance with the risk-based method, as explained in chapter 2. The premium as well as the provisions have to be calculated as best estimate. In order to ensure these the premium and the provisions are enough for the for a 99.5% confidence interval, the risk capital for a time horizon of 12 months is calculated. Four different methods can be used;

- The standard formula as proposed in the Solvency II manual. The formula is very general and applicable for all the different insurance companies throughout Europe.
- The standard model with specific parameters adjusted for a specific insurance. These adjustments ensure the risks which a certain insurance company's faces for a specific insurance are taken into account.
- The internal model are created by the company itself, the specific risk the company and the product is facing are taken into account.
- The last method is scaling whereby a smaller product can be scaled on a larger insurance. Cause by the mixed characteristic of the MPPI is this not possible.

As result from this research there can be concluded that internal models are preferred for risk capital establishment caused by the mixed product characteristics of the MPPI, as explained in chapter 7.

In order to define the risk capital, the MPPI characteristics, parameters, foundations and provisions have to be discussed to give the risk the MPPI is facing.

In the literature (Mortgage) Payment Protection Insurances are not widely discussed and information about the MPPI in the Netherlands is not available. The MPPI is a complex and expensive product, therefore research in order to revise the MPPI can be relevant to clarify the MPPI in the Netherlands. Having a house gives people the unique sensation of being a homeowner. In order to protect homeowners the MPPI is introduced. Becoming disabled or unemployed and still paying the monthly mortgage payment is challenging. In order to protect homeowners an MPPI can be closed. For a certain time depending on, becoming disabled or unemployed, the insured time period, maturity of the insurance, etc., the mortgage payment can be fulfilled. For an insured person it is important to display and inform the different possibilities for a MPPI transparently in order to fit the insurance to the habits and desires of the insured.
Resulting, different parameters and foundations are needed to establish a risk-based premium of the insured. Within the KAZO-model as defined by Gregorius (1992), the premium of an MPPI can be established. In order to fit the model to reality revised parameters and foundations have to be implemented. For the disability part, mortality, morbidity and recovery rates are important to derive the survival probabilities and the average durations of the disabled with a specific age and insured time period. For the unemployment part, the unemployment probability and the average duration for a given age-category are needed, discussed in chapter 4.

As a result, a parameter and foundation revision for the MPPI was needed, the premium has become more age and duration depended. A premium decrease of 55% can be realized, shown in chapter 5. In contrast for some of the insured the premium will increase, with a 7,2% as maximum. These effects confirmed the realized gains of the recent years. For some of the groups the damages are underestimated while for other groups the damages are overestimated. Therefore it can be concluded

that this premium revision will have an impact on the MPPI and the associated provisions and risks. With a rough estimate the premium revenues with the current as well with the new premium are determined. As result the premium revenue can decrease with 21.4% when implementing the new premium.
Revising the premium, results in the best estimate premium. Having the best estimated probabilities gives the opportunity to determine the provisions also with the best estimate method as required according to Solvency II. Consequently, these provisions can decrease as well. Depending on the time of being disabled and the insured duration the provisions will decrease more. The provisions can decrease up to 23%, for the current product in the first years of receiving a disability claim, as stated in chapter 6.

Identifying the foundations of the MPPI gives the opportunity to identify the risks of the MPPI as well. The foundations should correspond with the important risks of the MPPI, counterparty default risk, premium risk, reserve risk, catastrophe risk, expense risk and operational risk. In accordance with the foundations, premium and reserve risk are by magnitude the most important ones for the MPPI. Premium risk can be described as the risk of having enough premium during the maturity of the insurance in order to fulfil the claim requests of the client during for the next 12 months. Reserve risk can be described as the risk that the benefits and the claims handling of outstanding damage of older accident years is higher than expected, within a 12 months' time horizon (Achmea ppt 2014). Using the standard formula for defining these risks, the specific risks the MPPI is facing are not taken into account. The standard formulas are derived with data from all over Europa, to make it applicable for all insurance companies some additions where added, therefore the risks are established to generally. In order to define the risks more precisely internal models can be used. Caused by the recent launch the premium risk cannot be defined with an internal model for the coming five years, due to data restriction. For reserve risk more in-depth research is needed before a choice can be made. Calculating the reserve and premium risk with the standard model, a decrease in the risk capital of respectively 14.2% and 21.4% is visible as discussed in chapter 7.

As a result, a parameter and foundation revision for the MPPI, which is obtainable in the Dutch insurance market, was necessary. The premium and provisions have to be established with a best estimate method as required by Solvency II before defining the risks. As a consequence a revised premium should be introduced, the provisions should be derived in proportions to the probabilities, and resultant the risk capital can be derived on basis of the risks which are relevant for the MPPI. As result, updating the insurance with respect to Solvency II has besides the regulation also premium, provisions and risk capital benefits.

Chapter 9: Discussion and further research

During this study a more up to date premium, provision and risk model for the MPPI fulfilling the Solvency II regulations is delivered. Some issues have encountered and need more thorough analysis.
The premium model is revised with a parameter and foundation revision. The underlying method, the KAZO-model, is not changed. The inconvenient of this product is the disability and unemployment distinction. Therefore a separate study can be interesting in order to deliver a premium model based on the characteristics of the MPPI which establishes the premium in a more accurate way.
In this study a parameter and foundation revision is performed resulting some suggestions for further research can be given

- *Fixed or variable premium;* currently at the beginning of the insurance the insured get a premium which is constant till maturity. While the probabilities of becoming disability and unemployment varies though the time. To fit them to reality the premium can decrease for some years while for other years the premium should increase. Research about customer preferences is necessary before a choice, toward a variable or fixed premium, can be made.
- *Trends;* currently there are some indications for further trends, the most important are discussed below.
    - Employed vs. self-contracted; currently most of the customers are employed according to the data of the CBS a trend toward self-contracted is visible as mentioned in 4.3.4. This is an interesting shift which can have a significant effect.
    - Longer insured durations; as visible in chapter 3 the insured durations increase. Where in the past a maximum of 4 years was insured now up to 20 years can be insured.
    - Insured amount; in chapter 6 already the difference between insured amount for all the insured and the insured amount for the unemployed differ. Furthermore, a trend in higher insured amount is visible. Further research is needed to exclude whether these insured amount trends must be taken into account.
- *Back testing;*
    - Premium back testing; is needed in order to check whether the current observations are valid, does the dataset predict the future in a proper way. Furthermore, research is needed to determine how often the parameters should be updated, in order to keep the model up to date.
    - Retirement age; due to new regulation the retirement age is increased. Currently the probabilities of people who are 65 are used for people older than 65 since no disability and unemployment probabilities are available. Back testing is needed to check this assumption
- *Reserve risk;* further research should provide information before making a decision whether the internal model is applicable for determining the risk capital for reserve risk. The dataset and the model must fit for the MPPI. The model has to predict the extrapolating of payment patterns correctly.
- *Parameters;*
    - Interest rate; currently the interest rate of 3 percent is used, which is not realistic looking at the current ultimate forward rate. Further research is needed to define an interest rate which is applicable at the MPPI. A choice toward, a fixed or variable premium have to be made, depending on Achmea and client preferences. The interest rate is a product overarching problem.
    - Solvability charge; was settled on the same rate for the current as well for the proposed premium model because it was out of the scope of this research. An update of this rate is needed. Transforming this premium into the best estimate the profit marge is included in the solvability charge.

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Apendices

Appendix A: Glossary

Abbreviations	Descriptions
AFK	Afkoop; redemption
AFW	Afwijzing; Rejection
AG	Koninklijk Actuarieel Genootschap
CLA	Clausule; Contract Clause
CBS	Centraal Bureau voor de Statistiek
DNB	De Nederlandse Bank
EXP	Expiry; When a payout stops due to the ending of the insurance before the max payout period is reach.
HER	Herstel; Recovery
IM	Internal Model
MCR	Minimal capital requirement
MPPI	Mortgage Payment Protection Insurance
MXA	Max. Uitkeringstermijn Arbeidsongeschiktheid; Maximum payout period disability is reached
MXP	Max. Uitkering Polis; Maximum payout due to policy, a maximium payout of 300.000 euro is reached.
MXW	Max. uitkeringstermijn unemployment; Maximum payout period unemployment is reached
Nvt	Niet van toepassing; inapplicable
OPS	Opschorting; suspension by concealment
OVL	Overlijden; passing away
P@R	Profit at Risk
PIM	Partial Internal Model
PPI	Payment Protection Insurance
SCR	Solvency Capital requirements
UWV	Uitvoeringsinstituut Werknemersverzekeringen
VaR	Value at Risk
VZW	Verzwijging; Suppression
WGA	Werkhervatting gedeeltelijk arbeidsgeschikten
WIA	Wet werk en inkomen naar arbeidsvermogen

Appendix B: Policy conditions Hypotheekbescherming

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Appendix C: Portfolio proportions

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Appendix D: The chosen insured time period disability

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Input Figure 6 B, Insured period disability 2005-2014 current product

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Appendix E: Disability summary- Achmea

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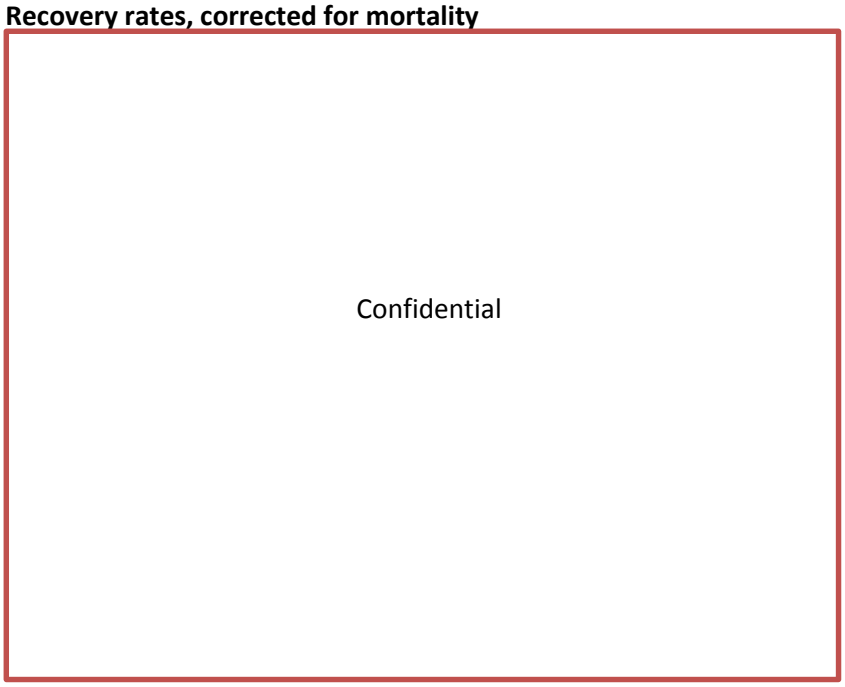
Appendix F: Mortality rates

		GBM9500	GBV9500
lft	Totaal	Mannen	Vrouwen
16	0,000399	0,000399	0,000223
17	0,000319	0,000471	0,000233
18	0,000394	0,00056	0,00025
19	0,000413	0,000624	0,000267
20	0,000416	0,000664	0,000269
21	0,000412	0,000671	0,000276
22	0,000415	0,000692	0,000284
23	0,000419	0,000697	0,000296
24	0,000419	0,000695	0,000303
25	0,000422	0,000691	0,000313
26	0,000431	0,000691	0,000329
27	0,000446	0,000686	0,000351
28	0,000463	0,000689	0,000371
29	0,00048	0,000703	0,000386
30	0,000504	0,000723	0,000409
31	0,000536	0,000757	0,000436
32	0,000576	0,000793	0,000474
33	0,000625	0,000834	0,000521
34	0,000682	0,00089	0,000573
35	0,000749	0,000945	0,000639
36	0,000828	0,001012	0,000717
37	0,00092	0,001088	0,00081
38	0,001018	0,001194	0,000896
39	0,001135	0,001317	0,000998
40	0,001273	0,001469	0,001119
41	0,00141	0,001621	0,001233
42	0,001554	0,001771	0,001367
43	0,001715	0,001961	0,001495

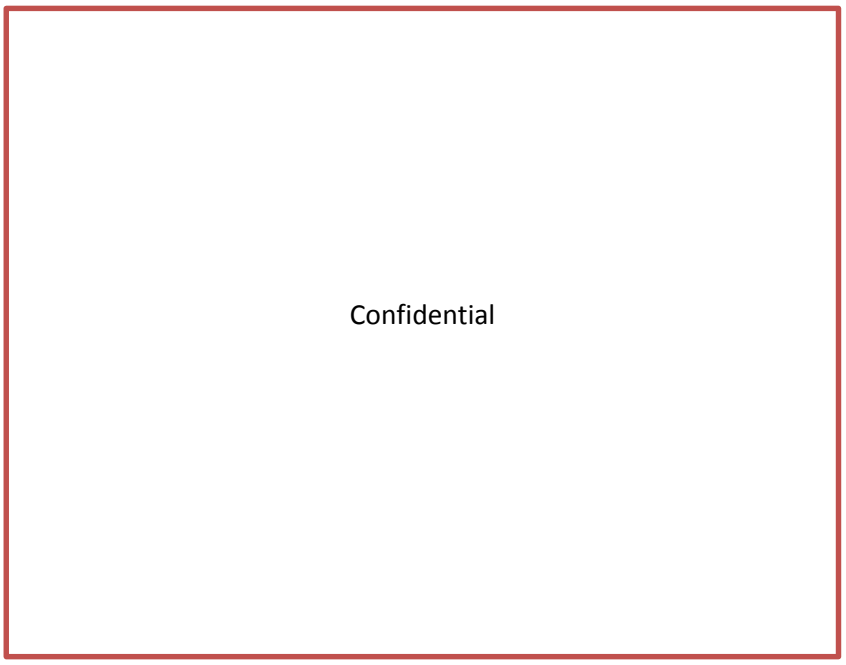
		GBM9500	GBV9500
lft	Totaal	Mannen	Vrouwen
44	0,001901	0,002177	0,001646
45	0,002096	0,002415	0,001787
46	0,002305	0,002656	0,001952
47	0,002525	0,00291	0,00212
48	0,002801	0,003222	0,002341
49	0,00309	0,003556	0,002555
50	0,003419	0,00396	0,002773
51	0,003764	0,004363	0,003012
52	0,00413	0,004808	0,003244
53	0,004575	0,005349	0,0035
54	0,005053	0,005929	0,003789
55	0,005578	0,006564	0,004095
56	0,006129	0,007234	0,004423
57	0,006783	0,008028	0,004794
58	0,007569	0,008961	0,005279
59	0,008426	0,009971	0,005781
60	0,009435	0,011183	0,006335
61	0,010623	0,01256	0,006958
62	0,011945	0,014154	0,007601
63	0,013425	0,015931	0,008297
64	0,015086	0,017908	0,00918
65		0,019948	0,010118
66		0,022166	0,011178
67		0,024622	0,012399
68		0,027263	0,013742
69		0,030085	0,01519
70		0,033365	0,016803

Appendix G: Realized recovery & retention rates

Recovery rates, corrected for mortality



Retention rates, corrected for mortality



Appendix H: Morbidity rates

***Partial disabled* $35-80$ %**

$x \leq 20$, $\quad i(x) = 5.289 * 10^{-4}$

$x > 20$, $\quad i(x) = 1{,}709 * 10^{-3} - 2{,}096 * 10^{-4} * x + 9{,}462 * 10^{-6} * x^2 - 9{,}987 * 10^{-8} * x^3 + 1{,}596 * 10^{-10} * x^4$

***Partial disabled* $80-100$ %**

$x \leq 20$, $\quad i(x) = 0.685 * 6.398 * 10^{-4}$

$x > 20$, $\quad i(x) = 0.685 * (-5.153 * 10^{-3} + 4.306 * 10^{-4} * x - 7.334 * 10^{-6} * x^2 + 4.227 * 10^{-9} * x^3 - 5.068 * 10^{-10} * x^4)$

Fully Occupationally disabled

$x \leq 20$, $\quad i(x) = 4.219 * 10^{-4}$

$x > 20$, $\quad i(x) = -3.469 * 10^{-3} + 3.024 * 10^{-4} * x - 6.962 * 10^{-6} * x^2 + 7.848 * 10^{-8} * x^3$

$x = age\ of\ insured$

$i(x) = mortbidity\ rates\ for\ age\ group\ x$

Correction factors:

WGA – 35-80 %: XXX

WGA – 80-100%: XXX

IVA: XXX

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Appendix I: Recovery & Retention– Verbondsmodel 2006

***Partial disabled* 35 − 80 %**

$r_2(x) = 0.167 - 2.56 * 10^{-3} * (x-2)$
$r_3(x) = 0.218 - 2.54 * 10^{-3} * (x-3)$
$r_4(x) = 0.158 - 2.11 * 10^{-3} * (x-4)$
$r_5(x) = 0.128 - 1.67 * 10^{-3} * (x-5)$
$r_6(x) = 0.128 - 1.67 * 10^{-3} * (x-6)$

***Partial disabled* 80 − 100 %**

$r_2(x) = 1.796 * 10^{-1} + 2.686 * 10^{-3} * (x-2) - 2.600 * 10^{-4} * (x-2)^2 + 6.521 * 10^{-6} * (x-2)^3 - 5.935 * 10^{-8} * (x-2)^4$
$r_3(x) = 7.208 * 10^{-1} - 3.719 * 10^{-2} * (x-3) + 1.441 * 10^{-3} * (x-3)^2 - 2.488 * 10^{-5} * (x-3)^3 + 1.348 * 10^{-7} * (x-3)^4$
$r_4(x) = 7.914 * 10^{-1} - 5.870 * 10^{-2} * (x-4) + 2.637 * 10^{-3} * (x-4)^2 - 5.264 * 10^{-5} * (x-4)^3 + 3.553 * 10^{-7} * (x-4)^4$
$r_5(x) = 6.084 * 10^{-1} - 3.579 * 10^{-2} * (x-5) + 1.641 * 10^{-3} * (x-5)^2 - 3.634 * 10^{-5} * (x-5)^3 + 2.677 * 10^{-7} * (x-5)^4$
$r_6(x) = 6.970 * 10^{-1} - 3.211 * 10^{-2} * (x-6) + 1.370 * 10^{-3} * (x-6)^2 - 3.210 * 10^{-5} * (x-6)^3 + 2.484 * 10^{-7} * (x-6)^4$

Fully Occupationally disabled

$r_2(x) = r_3(x) = r_4(x) = r_5(x) = r_6(x) = 0$

$x = age\ of\ insured$
$d = state\ d, for\ 2, \dots, 6$
$r_d(x) = mortbidity\ rates\ for\ age\ group\ x, and\ the\ state\ d$

Ratio –correction per age- category:

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The total recovery rates, corrected for the age category

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After having the recovery rates, the retention rates can be derived, as showed below.

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Appendix J: Corrected retention rates & survival opportunities

Corrected retention rates

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Survival opportunities

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Appendix K: Correction factors unemployment

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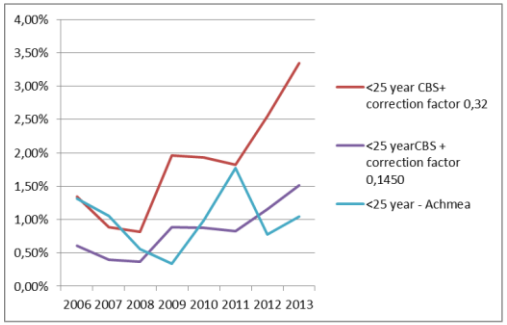

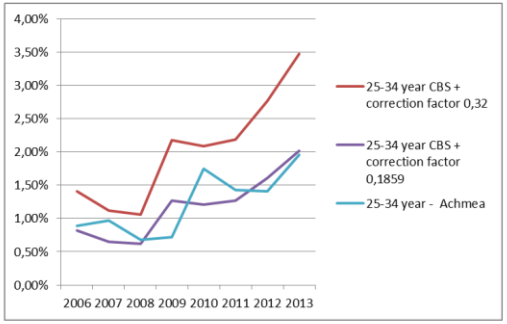

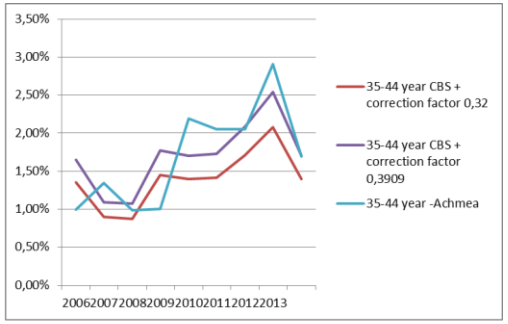

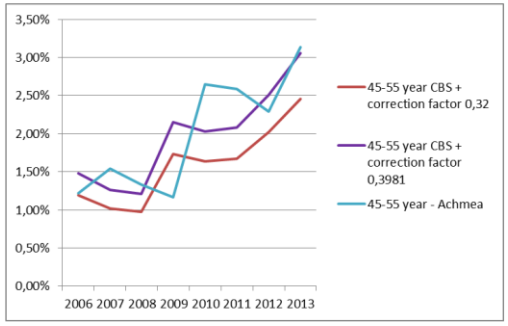

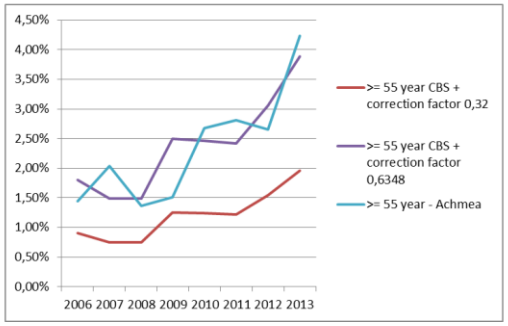

Appendix L: Unemployment duration - CBS

	<25 years	25-34 years	35-44 years	45-54 years	55-65 years	15-65 years	Total yearly
2006	5,0	6,4	8,1	9,2	10,6	8,9	7,8
2007	3,3	5,0	7,0	8,3	10,6	8,4	6,6
2008	3,3	4,4	6,4	7,7	10,2	7,7	6,1
2009	3,2	4,4	6,0	6,9	8,7	6,4	5,7
2010	3,1	4,3	6,5	7,6	8,8	6,9	5,9
2011	3,1	4,2	6,1	7,5	8,9	6,8	5,8
2012	3,1	4,2	6,1	7,2	8,6	6,6	5,7
2013	3,1	4,3	6,3	7,4	8,5	6,7	5,8
Average	3,4	4,7	6,6	7,7	9,4	7,3	6,2

		Scenario 1						Scenario 2				
	durations CBS	75% CBS weighted	25% max. weighted	87,5% CBS weighted	12,5% max. weighted	new duration		66,7% CBS weighted	33,3% max. weighted	80% CBS weighted	20% max. weighted	new duration
< 25 years	3,4	2,55	3			5,55		2,2667	4			6,27
25-34 years	4,7	3,525	3			6,53		3,1333	4			7,13
35-44 years	6,6			5,775	1,5	7,28				5,28	2,4	7,68
45-54 years	7,7			6,7375	1,5	8,24				6,16	2,4	8,56
>= 55 years	9,4			8,225	1,5	9,73				7,52	2,4	9,92

Appendix M: Unemployment summary - Achmea

Confidential

Appendix N: Interest rate

	Scenario		
	1	2	3
Insured amount	500	2500	500
Deferment period, in years	1	1	1
Insured time-period	4	5	20

		Scenario 1		Scenario 2		Scenario 3	
Insured period	**Document**	Monthly premium	Yearly premium	Monthly premium	Yearly premium	Monthly premium	Yearly premium
20 - 70 years	New 0%	9,98	119,76	42,96	515,52	27,08	324,96
20 - 65 years	Old 3%	8,7	104,40	34,65	415,80	19,73	236,76
20 -40 years	New 0%	7,04	84,48	25,09	301,08	13,84	166,08
20 -40 years	Old 3%	6,73	80,76	22,96	275,52	11,85	142,2
40 -70 years	New 0%	12,21	146,52	57,45	689,40	35,51	426,12
40 - 65 years	Old 3%	11,46	137,52	51,94	623,28	28,8	345,6

Appendix O: Effects of retirement-age

	Scenario			
	1	2	3	4
Insured amount	2500	500	350	500
Deferment period, in years	1	1	1	1
Insured time-period	5	20	4	5

		Scenario 1		Scenario 2		Scenario 3		Scenario 4	
Insured period	Document	Monthly premium	Yearly premium	Monthly premium	Yearly premium	Monthly premium	Yearly premium	Monthly premium	Yearly premium
20 - 70 years	New	34,56	414,72	20,44	245,28	7,08	84,96	9,59	115,08
20 - 65 years	Old	34,65	415,80	19,73	236,76	7,10	85,20	9,62	115,44
20 -40 years	New	22,96	275,52	11,85	142,20	5,72	68,64	7,28	87,36
20 -40 years	Old	22,96	275,52	11,85	142,20	5,72	68,64	7,28	87,36
40 -70 years	New	50,02	600,24	29,27	351,24	8,84	106,08	12,66	151,92
40 - 65 years	Old	51,94	623,28	28,80	345,60	9,03	108,36	13,08	156,96
35 -70 years	New	46,59	559,08	27,47	329,64	8,46	101,52	11,98	143,76
35 - 65 years	Old	47,74	572,88	26,89	322,68	8,58	102,96	12,24	146,88

Appendix P: Labor force – Employed vs. self-contracted

	Employed labor force										
	Total employed + self-contracted	Employed								Self-contracted	
		Total employed		Indefinite employment			Fixed employment				
Period	**x 1000**	**x 1 000**	**% Employed labor force**	**x 1 000**	**% Employed labor force**	**% Employed**	**x 1 000**	**% Employed labor force**	**% Employed**	**x 1 000**	**% Employed labor force**
2005	6973	6040	86,6%	5184	74,3%	85,8%	855	12,3%	14,2%	933	13,4%
2006	7097	6135	86,4%	5192	73,2%	84,6%	943	13,3%	15,4%	962	13,6%
2007	7309	6304	86,2%	5220	71,4%	82,8%	1084	14,8%	17,2%	1005	13,8%
2008	7500	6462	86,2%	5330	71,1%	82,5%	1132	15,1%	17,5%	1038	13,8%
2009	7469	6430	86,1%	5325	71,3%	82,8%	1105	14,8%	17,2%	1039	13,9%
2010	7391	6341	85,8%	5237	70,9%	82,6%	1104	14,9%	17,4%	1050	14,2%
2011	7392	6315	85,4%	5195	70,3%	82,3%	1120	15,2%	17,7%	1077	14,6%
2012	7387	6292	85,2%	5115	69,2%	81,3%	1177	15,9%	18,7%	1095	14,8%
2013	7284	6161	84,6%	4946	67,9%	80,3%	1215	16,7%	19,7%	1123	15,4%
Average	**7311**	**6276**	**85,8%**	**5194**	**71,1%**	**82,8%**	**1082**	**14,8%**	**17,2%**	**1036**	**14,2%**

Appendix Q: Prudence effect

Table 1: disability scenarios

Scenario- disability						
	1	2	3	4	5	6
insured amount	2500	2500	2500	500	500	500
own risk period Dis	1	1	1	1	1	1
Insured time period Dis	20	5	2	20	5	2
Insured time, EM	NV	NV	NV	NV	NV	NV

Table 2: Results of having no disability prudence

Disability- Current vs No prudence						
	1	2	3	4	5	6
20-65	-8,69%	-7,85%	-6,92%	-7,83%	-5,94%	-4,38%
20-40	-8,16%	-7,09%	-5,90%	-6,58%	-4,67%	-3,10%
40-65	-8,78%	-8,20%	-7,39%	-8,11%	-6,63%	-5,02%

Table 3: unemployment scenarios

Scenario- unemployment							
	1	2	3	4	5	6	7
Insured amount	2500	1000	500	500	1000	1500	2500
Own risk period Dis	1	1	1	1	1	1	1
Insured time period Dis	5	5	5	4	4	4	4
Insured time, EM	12	12	12	12	12	12	12

Table 4: Results of having no disability prudence

Unemployment- Current vs current-no prudence																				
	scenario 1			scenario 2			scenario 3			scenario 4			scenario 5			scenario 6			scenario 7		
Prudence	Yes	No	%	Yes	No	%	Yes	No	%	Yes	No	%	Yes	No	%	Yes	No	%	Yes	No	%
20-65	100,32	89,55	-10,7	42,14	37,84	-10,2	22,75	20,60	-9,5	21,70	19,57	-9,8	40,04	35,78	-10,6	58,37	51,99	-10,9	95,05	84,40	-11,2
20-40	97,70	88,90	-9,0	41,10	37,58	-8,6	22,23	20,47	-7,9	21,11	19,23	-8,9	38,85	35,10	-9,7	56,60	50,97	-9,9	92,09	82,71	-10,2
40-65	111,36	101,54	-8,8	46,52	42,63	-8,4	24,94	23,00	-7,8	23,00	21,11	-8,2	42,64	38,85	-8,9	62,27	56,59	-9,1	101,51	92,08	-9,3

Appendix R: Explanation premium model

Confidential

Confidential

Appendix S: Premium effects- disability part

Table 1: the different scenarios

	Scenario					
	1	2	3	4	5	6
Insured amount	2500	2500	2500	500	500	500
Own risk period Dis	1	1	1	1	1	1
Insured time period Dis	20	5	2	20	5	2
Insured time, EM	NV	NV	NV	NV	NV	NV

Table 2: The premium of the different scenarios with the different underlying probabilities

	SCENARIO 1				SCENARIO 2				SCENARIO 3			
	current	new	realized	New + correction	current	new	realized	New + correction	current	new	realized	New + correction
20-65	121,94	134,97	57,64	58,4	42,95	46,37	25,25	25,6	23,12	23,98	17,29	17,51
20-40	55,76	61,08	33,63	33,78	25,09	26,94	17,57	17,42	15,6	16,24	13,05	12,89
40-65	164,08	182,52	73,72	74,74	57,45	61,91	31,72	32,32	29,36	30,38	20,86	21,30

Table 3: The premium of the different scenarios with the different underlying probabilities

	SCENARIO 4				SCENARIO 5				SCENARIO 6			
	current	new	realized	New + correction	current	new	realized	New + correction	current	new	realized	New + correction
20-65	27,08	29,68	14,22	14,37	11,28	11,96	7,74	7,81	7,31	7,48	6,15	6,19
20-40	13,84	14,91	9,42	9,45	7,71	8,08	6,21	6,17	5,81	5,94	5,3	5,27
40-65	35,51	39,20	17,43	17,64	14,18	15,07	9,03	9,15	8,56	8,77	6,86	6,95

Table 4: Premium effect; Current versus New

Current vs. new						
	1	2	3	4	5	6
20-65	10,7%	8,0%	3,7%	9,6%	6,0%	2,3%
20-40	9,5%	7,4%	4,1%	7,7%	4,8%	2,2%
40-65	11,2%	7,8%	3,5%	10,4%	6,3%	2,5%

Table 5: Premium effect; Current versus Realized

Current vs. Realized						
	1	2	3	4	5	6
20-65	-52,7%	-41,2%	-25,2%	-47,5%	-31,4%	-15,9%
20-40	-39,7%	-30,0%	-16,3%	-31,9%	-19,5%	-8,8%
40-65	-55,1%	-44,8%	-29,0%	-50,9%	-36,3%	-19,9%

Table 6: Premium effect; Current versus New+ correction

Current vs. New + corrections						
	1	2	3	4	5	6
20-65	-52,1%	-40,4%	-24,3%	-46,9%	-30,8%	-15,3%
20-40	-39,4%	-30,6%	-17,4%	-31,7%	-20,0%	-9,3%
40-65	-54,4%	-43,7%	-27,5%	-50,3%	-35,5%	-18,8%

Table 7: Premium effect; Realized versus New + correction

Realized vs. New + corrections						
	1	2	3	4	5	6
20-65	1,3%	1,4%	1,3%	1,1%	0,9%	0,7%
20-40	0,4%	-0,9%	-1,2%	0,3%	-0,6%	-0,6%
40-65	1,4%	1,9%	2,1%	1,2%	1,3%	1,3%

Appendix T: Results back test disability

Table 1- Characteristic of the old product

Confidential

Table 2- Characteristic of the current product

Confidential

Table 3- Characteristic of the both products

Confidential

Table 4- Survival probabilities

Confidential

Table 5- Disabled people per ag-category with respect to the number of insured people of both products

Confidential

Table 6- The amount of damage using the averages of the old product

Confidential

Table 7-The amount of damage using the averages of the current product

Confidential

Table 8 - The amount of damage using the averages of both products

Confidential

Appendix U: Premium effects – unemployment part

Table 1: Different scenarios

Scenarios							
	1	2	3	4	5	6	7
Insured amount	2500	1000	500	500	1000	1500	2500
Own risk period Dis	1	1	1	1	1	1	1
Insured time period Dis	5	5	5	4	4	4	4
Insured time, EM	12	12	12	12	12	12	12

Table 2: Premium effect after implementing the correction factors

Effect correction factor												
	scenario 1			scenario 2			scenario 3			scenario 4		
	OUD	NIEUW	%	OUD	NIEUW	%	OUD	NIEUW	%	OUD	NIEUW	%
20-65	100,32	67,05	-33,2%	42,14	28,84	-31,6%	22,75	16,10	-29,2%	21,70	15,12	-30,3%
20-40	97,70	59,75	-38,8%	41,10	25,92	-36,9%	22,23	14,64	-34,1%	21,11	13,81	-34,6%
40-65	111,26	81,26	-27,0%	46,52	34,52	-25,8%	24,94	18,94	-24,1%	23,00	17,17	-25,3%

Table 3: Premium effect after implementing the correction factors, probabilities and the durations

Effect of the correction factors, probabilities and the duration																				
	scenario 1			scenario 2			scenario 3			scenario 4			scenario 5			scenario 6			scenario 7		
	OUD	NIEUW	%	OUD	NIEUW	%	OUD	NIEUW	%	OUD	NIEUW	%	OUD	NIEUW	%	OUD	NIEUW	%	OUD	NIEUW	%
20-65	100,32	71,02	-29,2	42,14	30,43	-27,8	22,75	16,90	-25,7	21,70	15,91	-26,7	40,04	28,45	-28,9	58,37	40,99	-29,8	95,05	66,08	-30,5
20-40	97,70	52,63	-46,1	41,10	23,07	-43,9	22,23	13,22	-40,5	21,11	12,44	-41,1	38,85	21,52	-44,6	56,60	30,60	-45,9	92,09	48,77	-47,0
40-65	111,36	103,82	-6,8	46,52	43,55	-6,4	24,94	23,46	-5,9	23,00	21,55	-6,3	42,64	39,74	-6,8	62,27	57,93	-7,0	101,51	94,07	-7,3

Appendix V: Results back test unemployment

Table 1: Estimated damage of the current product

	Confidential	Estimated/Realized
<25		77,38%
25-34		92,18%
35-44		78,30%
45-54		56,27%
>55		69,33%
Total		75,20%

Table 2: Estimated damage of the old product

	Confidential	Estimated/Realized
<25		
25-34		47,7%
35-44		124,4%
45-54		78,6%
>55		122,0%
Total		98,4%

Table 3: Estimated damage of both products together with insured amount of the current product

	Confidential	Estimated/Realized
<25		87,19%
25-34		85,62%
35-44		117,50%
45-54		80,78%
>55		124,12%
Total		100,59%

Table 4: difference insured amount all insured versus all unemployment- claims

	Insured amount				
Description	**< 25**	**25-34**	**35-44**	**45-54**	**>55**
HYB- all	Confidential				
HBC- all					
HYB- dam.					
HBC- dam.					
Both products- dam.					

Appendix W: Effects current vs new premium model

Possibility 1- interest rate is equal to 3 % in both premium models

Table 1: the 6 different scenarios

	scenario 1		scenario 2		scenario 3		scenario 4		scenario 5		scenario 6	
kind of premium	Old prem.	new prem	Old prem.	new prem	Old prem.	new prem	Old prem.	new prem	Old prem.	new prem	Old prem.	new prem
insured amount	2500	2500	2500	2500	2500	2500	500	500	500	500	500	500
own risk period	1	1	1	1	1	1	1	1	1	1	1	1
insured time AO	20	20	5	5	2	2	20	20	5	5	2	2
Interest rate	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%

Table 2: The premiums for the first three scenarios

	old						new					
	scenario 1- 20 yr.		scenario 2-5 yr.		scenario 3- 2 yr.		scenario 1- 20 yr.		scenario 2-5 yr.		scenario 3- 2 yr.	
Insured unemployment	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
20-65	154,92	85,19	100,32	34,65	84,82	19,84	82,42	53,00	59,14	29,72	50,01	20,59
20-40	142,01	45,82	97,70	22,96	86,64	14,77	67,02	43,74	45,62	22,34	38,98	15,70
40-65	201,31	130,54	111,26	51,94	85,30	27,61	112,47	71,24	84,70	43,70	70,83	29,60

Table 3: The premiums for the last three scenarios

	old						new					
	scenario 4- 20 yr.		scenario 5-5 yr.		scenario 6- 2 yr.		scenario 4- 20 yr.		scenario 5-5 yr.		scenario 6- 2 yr.	
Insured unemployment	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
20-65	33,68	19,78	22,75	9,62	19,66	6,66	18,5	12,62	13,85	7,96	12,02	6,14
20-40	31,09	11,85	22,23	7,28	20,02	5,56	15,42	10,77	11,14	6,49	9,81	5,16
40-65	42,95	28,8	24,94	13,08	19,75	8,31	24,51	16,27	18,96	10,71	16,18	7,94

Table 4: the premium effects for the first three scenarios

	scenario 1 - 20 yr.		scenario 2 - 5 yr.		scenario 3 - 2 yr.	
Insured unemployment	Yes	No	Yes	No	Yes	No
20-65	-46,8%	-37,8%	-41,0%	-14,2%	-41,0%	3,8%
20-40	-52,8%	-4,5%	-53,3%	-2,7%	-55,0%	6,3%
40-65	-44,1%	-45,4%	-23,9%	-15,9%	-17,0%	7,2%

Table 5: The premium effects for the last three scenarios

	scenario 4- 20 yr.		scenario 5-5 yr.		scenario 6- 2 yr.	
Insured unemployment	Yes	No	Yes	No	Yes	No
20-65	-45,1%	-36,2%	-39,1%	-17,3%	-38,9%	-7,8%
20-40	-50,4%	-9,1%	-49,9%	-10,9%	-51,0%	-7,2%
40-65	-42,9%	-43,5%	-24,0%	-18,1%	-18,1%	-4,5%

Possibility 2 – interest rate is equal to 0.1 %in both premium models

Table 1: the 6 different scenarios

	scenario 1		scenario 2		scenario 3		scenario 4		scenario 5		scenario 6	
kind of premium	Old prem.	new prem	Old prem.	new prem	Old prem.	new prem	Old prem.	new prem	Old prem.	new prem	Old prem.	new prem
insured amount	2500	2500	2500	2500	2500	2500	500	500	500	500	500	500
own risk period	1	1	1	1	1	1	1	1	1	1	1	1
insured time AO	20	20	5	5	2	2	20	20	5	5	2	2
Interest rate	0,1%	0,1%	0,1%	0,1%	0,1%	0,1%	0,1%	0,1%	0,1%	0,1%	0,1%	0,1%

Table 2: The premiums for the first three scenarios

	old						new					
	scenario 1- 20 yr.		scenario 2-5 yr.		scenario 3- 2 yr.		scenario 1- 20 yr.		scenario 2-5 yr.		scenario 3- 2 yr.	
Insured unemployment	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
20-65	193,47	120,48	107,87	42,67	86,94	23,02	102,06	57,21	69,89	35,96	58,21	24,28
20-40	160,08	55,41	101,26	25,03	87,97	15,60	81,83	68,13	49,63	25,02	41,70	17,08
40-65	240,93	162,77	118,86	57,23	88,56	29,29	124,32	80,65	90,74	47,07	75,28	31,60

Table 3: The premiums for the last three scenarios

	old						new					
	scenario 4- 20 yr.		scenario 5-5 yr.		scenario 6- 2 yr.		scenario 4- 20 yr.		scenario 5-5 yr.		scenario 6- 2 yr.	
Insured unemployment	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
20-65	41,38	26,79	24,26	11,22	20,08	7,29	22,43	15,46	15,99	9,21	13,66	6,87
20-40	34,71	13,77	22,94	7,7	20,28	5,81	18,38	13,46	11,94	7,02	10,36	5,44
40-65	50,88	35,25	26,46	14,14	20,4	8,55	26,88	18,15	20,17	11,43	17,87	8,34

Table 4: the premium effects for the first three scenarios

	scenario 1 - 20 yr.		scenario 2 - 5 yr.		scenario 3 - 2 yr.	
Insured unemployment	Yes	No	Yes	No	Yes	No
20-65	-47,2%	-52,5%	-35,2%	-15,7%	-33,0%	5,5%
20-40	-48,9%	23,0%	-51,0%	0,0%	-52,6%	9,5%
40-65	-48,4%	-50,5%	-23,7%	-17,8%	-15,0%	7,9%

Table 5: The premium effects for the last three scenarios

	scenario 4- 20 yr.		scenario 5-5 yr.		scenario 6- 2 yr.	
Insured unemployment	Yes	No	Yes	No	Yes	No
20-65	-45,8%	-42,3%	-34,1%	-17,9%	-32,0%	-5,8%
20-40	-47,0%	-2,3%	-48,0%	-8,8%	-48,9%	-6,4%
40-65	-47,2%	-48,5%	-23,8%	-19,2%	-12,4%	-2,5%

Possibility 3 – interest rate is 3% for the current premium model en 0.1% for the new premium model

Table 1: the 6 different scenarios

	scenario 1		scenario 2		scenario 3		scenario 4		scenario 5		scenario 6	
kind of premium	Old prem.	new prem	Old prem.	new prem	Old prem.	new prem	Old prem.	new prem	Old prem.	new prem	Old prem.	new prem
insured amount	2500	2500	2500	2500	2500	2500	500	500	500	500	500	500
own risk period	1	1	1	1	1	1	1	1	1	1	1	1
insured time AO	20	20	5	5	2	2	20	20	5	5	2	2
Interest rate	3%	0,1%	3%	0,1%	3%	0,1%	3%	0,1%	3%	0,1%	3%	0,1%

Table 2: The premiums for the first three scenarios

	old						new					
	scenario 1- 20 yr.		scenario 2-5 yr.		scenario 3- 2 yr.		scenario 1- 20 yr.		scenario 2-5 yr.		scenario 3- 2 yr.	
Insured unemployment	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
20-65	154,92	85,19	100,32	34,65	84,82	19,84	102,06	57,21	69,89	35,96	58,21	24,28
20-40	142,01	45,82	97,70	22,96	86,64	14,77	81,83	68,13	49,63	25,02	41,70	17,08
40-65	201,31	130,54	111,26	51,94	85,30	27,61	124,32	80,65	90,74	47,07	75,28	31,60

Table 3: The premiums for the last three scenarios

	old						new					
	scenario 4- 20 yr.		scenario 5-5 yr.		scenario 6- 2 yr.		scenario 4- 20 yr.		scenario 5-5 yr.		scenario 6- 2 yr.	
Insured unemployment	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
20-65	33,68	19,78	22,75	9,62	19,66	6,66	22,43	15,46	15,99	9,21	13,66	6,87
20-40	31,09	11,85	22,23	7,28	20,02	5,56	18,38	13,46	11,94	7,02	10,36	5,44
40-65	42,95	28,8	24,94	13,08	19,75	8,31	26,88	18,15	20,17	11,43	17,87	8,34

Table 4: the premium effects for the first three scenarios

	scenario 1 - 20 yr.		scenario 2 - 5 yr.		scenario 3 - 2 yr.	
Insured unemployment	Yes	No	Yes	No	Yes	No
20-65	-34,1%	-32,8%	-30,3%	3,8%	-31,4%	22,4%
20-40	-42,4%	48,7%	-49,2%	9,0%	-51,9%	15,6%
40-65	-38,2%	-38,2%	-18,4%	-9,4%	-11,7%	14,5%

Table 5: The premium effects for the last three scenarios

	scenario 4 - 20 yr.		scenario 5 - 5 yr.		scenario 6 - 2 yr.	
Insured unemployment	Yes	No	Yes	No	Yes	No
20-65	-33,4%	-21,8%	-29,7%	-4,3%	-30,5%	3,2%
20-40	-40,9%	13,6%	-46,3%	-3,6%	-48,3%	-2,2%
40-65	-37,4%	-37,0%	-19,1%	-12,6%	-9,5%	0,4%

Appendix X: Retention rates up to 20 years

Confidential

Appendix Y: Disability durations

Confidential

20 years

Confidential