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Sponsor Support Valuation According to the IORP II Directive Applied to Dutch Pension Funds

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Sponsor support valuation according to the IORP II Directive applied to Dutch pension funds

by

S.H.G. van Helvert (s811932)

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Supervised by:

Prof. dr. B.J.M. Werker (Tilburg University)

M.L.G. Penders MSc. AAG (Towers Watson)

Second reader:

Prof. dr. J.M. Schumacher (Tilburg University)

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Abstract

This thesis investigates the consequences of applying sponsor support valuation according to the IORP II Directive to Dutch pension funds. In the IORP II Directive a policy option is proposed by EIOPA in which a holistic balance sheet approach is introduced. Sponsor support is a conditional asset on the asset side of the holistic balance sheet. An advantage of the holistic balance sheet approach is that pension funds with different pension systems and different steering and security mechanisms can be better compared than before introducing the holistic balance sheet approach. Another advantage is that it provides harmonization of monitoring. We value sponsor support under two different methods. One method is a combination of the Black-Scholes and the Vasicek model and the other method is using the risk-neutral economic scenario set which is generated by MoSes Economic Scenario Generator. Our research shows that sponsor support can be a significant amount if a minimum funding ratio is ensured by the sponsor and can therefore be an important asset on the holistic balance sheet. Most sponsors haven't those resources, therefore it will be a hard task for the sponsor to ensure this minimum funding ratio. Moreover, in the future this kind of contracts may be modified or may even disappear. When we introduce the policy of cutting pensions, our research shows that sponsor support is much less than without cutting pensions and therefore a sponsor needs less resources. We can conclude from the holistic balance sheet approach that it offers interesting insights, but in its current form is unsuitable as monitoring tool due to the unclear definition of sponsor support.

Contents

Chapter 1

Introduction and problem motivation

1.1 Problem motivation

September 23, 2003, the European Pension Funds Directive (IORP[1] directive) came into force. The main reason to introduce this directive was to increase competition in the European market for pension provision. Countries in the European Community had two years to insert this directive into national law. The IORP Directive is brief and gives some general requirements for the maintenance of capital. In the IORP Directive is defined that pension provision must be set in a prudent manner. Therefore, the European Commission (EC) would like to have an adequate, sustainable and safe European pension system and would like to have an adequate supervision of IORPs. In July 2010, the EC published a Green paper with as main themes:

- Achieving adequate and sustainable pensions
- Protecting the value and security of pension provision
- Improving portability of pension rights
- Promoting the internal market to maximize efficiency of provision, by review of the IORP Directive

The European Parliament stresses about the Green Paper that financial markets can function efficiently only when there is confidence and trust and considers that confidence and trust require solid prudential rules for financial institutions. After consultation of the Green Paper the EC asked EIOPA[2] to provide advice on the review of the IORP Directive, Call for Advice. The review of the IORP Directive (hereafter: IORP II Directive) is based on Solvency II for insurers. In the IORP II Directive a policy option is proposed by EIOPA in which a holistic balance sheet (HBS) approach is introduced. In Europe there are many pension systems with differences in the method of financing, the involvement of social partners and the type of pension. The EC would like to have a harmonization of monitoring for these pension systems. EIOPA introduces the HBS as a way to achieve the Commission's aim for harmonization. The Call for Advice is mainly about this HBS approach. In the HBS approach not only available assets are given a place on the pension funds balance sheet, but also other steering and security mechanisms. Examples for these mechanisms are sponsor guarantees, conditional contribution increases, and a contractual reduction of benefits (Broeders et al., 2012). For an overview of the difference between a Traditional Balance Sheet and the HBS, see Figure 1.1.1.

[1] IORP: Institution for Occupational Retirement provision
[2] EIOPA: European Insurance and Occupational Pensions Authority

The publication of EIOPA Final Advice follows an extensive period of stakeholder consultation. EIOPA's Final Advice on the IORP II Directive was delivered to the EC on 15 February 2012. The Chairman of EIOPA, Gabriel Bernardino (2012), said about EIOPA's advice: "I am pleased that we have been able to take this important step in the development of a new European framework for occupational pension funds. In our advice to the European Commission we proposed the holistic balance sheet (HBS) concept as a means to capture the wide diversity of retirement systems in a single prudential regime. This QIS will allow us to investigate the feasibility of implementing the HBS in practice." Beside the Call for Advice also requested EIOPA to perform a Quantitative Impact Study (QIS) on the quantitative aspects of its advice. Until 31 July 2012 EIOPA has a public consultation on the "Draft Technical Specifications QIS of EIOPA's Advice on the Review of the IORP Directive". EIOPA received responses from several countries and several European and international organizations. Consequently, on 2 October 2012 EIOPA published the revised "Draft Technical Specifications QIS of EIOPA's Advice on the Review of the IORP Directive" and submitted them to the EC for its consideration. On 16 October 2012 EIOPA launches the first QIS on IORPs. At this moment the QIS will be tested and then EC decided whether the IORP II Directive came into force in 2014.

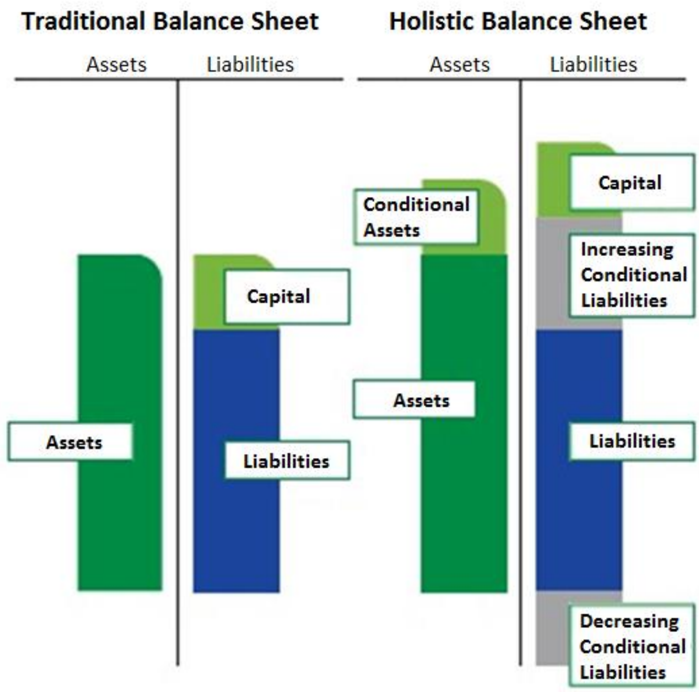

Figure 1.1.1: Traditional Balance Sheet versus Holistic Balance Sheet

This thesis investigates the consequences of the introduction of the IORP II Directive on the valuation of sponsor support. We specifically look at an application of the directive to Dutch pension funds with different sponsor guarantees. We value sponsor support under different methods and investigate what the advantages and disadvantages of the IORP II Directive are.

Summarizing, in this thesis the following research question will be investigated:
"What are the consequences of applying sponsor support valuation according to the IORP II Directive to Dutch pension funds?"

1.2 Company profile

This thesis has been written during an internship at Towers Watson. Towers Watson is a leading global consultancy company, with 14,000 associates around the world, that advises organizations in order to improve their performance in the areas of financial and risk management and Human Resources. In January 2010, Towers Watson was formed by the merger of Towers Perrin and Watson Wyatt. In the Netherlands, Towers Watson has 450 employees divided over six offices. Towers Watson works for a lot of different clients, like pension funds, insurance companies, small and medium-sized enterprises, as well as multinationals.

1.3 Structure thesis

In the next chapter, we will start with an explanation of the financial market that we will use. In order to value sponsor support we will simulate a lot of financial market scenarios. Therefore it is necessary to make assumptions on the characteristics of the market. In this chapter these characteristics will be explained. First we look at the real world versus the risk-neutral world. Then we describe the Black-Scholes model and pricing kernels. Afterwards the Vasicek model will be explained. Finally we combine Black-Scholes and Vasicek.

The Call for Advice was mainly about the holistic balance sheet approach. In Chapter 3 this approach will be discussed. First the design of the holistic balance sheet is explained and a comparison between the traditional balance sheet and a holistic approach is made. Thereafter we describe the funding ratio of a pension fund when using the holistic approach. In the last two sections advantages and challenges of the holistic balance sheet approach are given.

In Chapter 3 we have discussed the holistic balance sheet approach. The asset side of the HBS consists of assets and conditional assets. An example of a conditional asset is sponsor support. In this thesis we focus on this conditional asset. In Chapter 4, first we give the definition of sponsor support by EIOPA. Thereafter we describe our definition of sponsor support. Finally in order to value sponsor support in the following chapters, the assumptions of sponsor support will be given.

The focus of Chapter 5 is valuing sponsor support in the real world using Black-Scholes and the Vasicek model. First we give a description of Black-Scholes in combination with Vasicek. Then we will describe the data and define the input parameters of several different variables and which asset mix we use. Thereafter we simulate 10,000 scenarios and determine the possible additional sponsor payments. Finally we will give the results of our simulation.

The focus of Chapter 6 is valuing sponsor support in the risk-neutral world using the risk-neutral economic scenario set which has been developed by Towers Watson. This risk-neutral economic scenario set is generated by the MoSes Economic Scenario Generator. First we give a description of MoSes. Then we will describe the data and define the input parameters of several different variables and which asset mix we use. Thereafter we simulate 1,000 scenarios and determine the possible additional sponsor payments for two different pension funds. Finally we will give the results of our simulations for both pension funds and end the section with a comparison between these pension funds.

Before we can draw any conclusions a sensitivity analysis has to be performed. Therefore in Chapter 7, we will investigate the sensitivity of the model. We will start with a sensitivity analysis on the impact of different financial markets. Secondly, we will look at different initial values of the pension fund. Next we will investigate the impact of policy of a pension fund, like asset mix, cutting pensions and indexation. Lastly, the impact of different initial values of the financial market will be performed.

Finally, in section 1 of Chapter 8 we will give our conclusions. The conclusions will be based on the results from Chapter 5 and 6 and the performed sensitivity analysis of Chapter 7. Furthermore we will have two discussions. One discussion is about the initial idea of introducing the holistic balance sheet approach and thereafter we will discuss the IORP II Directive in general. The last section provides some recommendations for further research which are derived from this thesis.

Chapter 2

The Market

In order to value sponsor support we will simulate a lot of financial market scenarios. Therefore it is necessary to make assumptions on the characteristics of the market. In this chapter these characteristics will be explained. First we look at the real world versus the risk-neutral world. Then we describe the Black-Scholes model and pricing kernels. Afterwards the Vasicek model will be explained. Finally we combine Black-Scholes and Vasicek.

2.1 Real world versus risk-neutral world

In this section the real world and the risk-neutral world will be explained. Furthermore we will explain the relationship between these two worlds and what the stochastic behavior of stock prices is in the two worlds. In the real world $\mathbb{P}$ investors are assumed to be risk averse. Therefore the investors, who are bearing the risk, want a reward for their risk taking. The reward is in the form of a risk premium $\lambda\sigma$. While in the risk-neutral world $\mathbb{Q}$ investors are indifferent towards risk.

If $\mathbb{P}$ and $\mathbb{Q}$ are given measures, and if there exists a random variable θ such that:

$$E^{\mathbb{Q}}X = E^{\mathbb{P}}\theta X \qquad (2.1.1)$$

for all random variables X, then θ is the Radon-Nikodym derivative of $\mathbb{Q}$ with respect to $\mathbb{P}$. One also writes $\frac{d\mathbb{Q}}{d\mathbb{P}}$ instead of θ. In other words if you change measures and use the Radon-Nikodym derivative under $\mathbb{P}$, then the price in the real world is equal to the price in the risk-neutral world.

2.2 Black-Scholes

In this section the characteristics of the Black-Scholes market (Black and Scholes, 1973) will be explained. Black-Scholes considers a simple market with only one risky asset, a stock, and one riskless asset, a bond. The stochastic behavior of the price of the riskless asset B_t, bond price, and a fixed interest rate r is given by:

$$dB_t = rB_t dt \qquad (2.2.1)$$

The stochastic behavior of the stock price under the risk-neutral world measure $\mathbb{Q}$ can be described as:

$$dS_t = rS_t dt + \sigma_S S_t dW_{St}^{\mathbb{Q}} \qquad (2.2.2)$$

where,

r = interest rate

σ_S = stock volatility level

$W_{St}^{\mathbb{Q}}$ = Brownian Motion[3] of the stock price under the risk-neutral measure $\mathbb{Q}$

Following the Girsanov Theorem (Girsanov, 1960) the real world Brownian motion is defined as:

$$dW_t^{\mathbb{P}} = dW_t^{\mathbb{Q}} - \lambda dt \tag{2.2.3}$$

Combining (2.2.2) and (2.2.3) the stochastic behavior of the stock price under the real world measure $\mathbb{P}$ can be described as:

$$\begin{aligned} dS_t &= (r + \lambda_S \sigma_S) S_t dt + \sigma_S S_t dW_{St}^{\mathbb{P}} \\ &= \mu_S S_t dt + \sigma_S S_t dW_{St}^{\mathbb{P}} \end{aligned} \tag{2.2.4}$$

where,

r = interest rate

$\lambda_S \sigma_S$ = risk premium

μ_S = expected return on stock

$W_{St}^{\mathbb{P}}$ = Brownian motion of the stock price under the real world measure $\mathbb{P}$

Under the real world measure $\mathbb{P}$ is the expected return equal to the interest rate r plus a risk premium $\lambda_S \sigma_S$.

Black-Scholes assumes a constant drift and a constant stock volatility level. Furthermore they assume no arbitrage opportunities exist and there are no transaction costs. We derive the stock price and the bond price by applying Itô's lemma to respectively $Y_t = \log(S_t)$ and $Y_t = \log(B_t)$ and becomes:

$$S_t = S_0 \exp\left(\left(\mu_S - \frac{1}{2}{\sigma_S}^2\right) t + \sigma_S W_{St}\right) \tag{2.2.5}$$

$$B_t = B_0 \exp(rt) \tag{2.2.6}$$

2.3 Pricing kernel

This section explains the stochastic behavior of a pricing kernel and defines the value of the contract with using pricing kernels. In Section 2.2 the stochastic behavior of the stock price under the real world measure $\mathbb{P}$ is given in equation (2.2.4). The Girsanov Theorem helps us to relate the real world measure with the risk-neutral measure. Then from the Girsanov Theorem, the Radon-Nikodym derivative $\frac{d\mathbb{Q}}{d\mathbb{P}}$ (Schrager, 2002) will be:

[3] A Brownian motion satisfies the following properties: (i) $W_0 = 0$, (ii) If $t_1 < t_2 \leq t_3 < t_4$, then the increments $W_{t_2} - W_{t_1}$ and $W_{t_4} - W_{t_3}$ are independent, (iii) For any given t_1 and t_2 with $t_2 > t_1$, then $W_{t_2} - W_{t_1} \sim N(0, t_2 - t_1)$

$$\frac{d\mathbb{Q}}{d\mathbb{P}}[0,t] = \exp\left(-\frac{1}{2}\int_0^t \lambda^2 ds - \int_0^t \lambda dW_s^{\mathbb{P}}\right) \tag{2.3.1}$$

where,

$\lambda =$ price of risk

Under Black-Scholes the price of risk is $\lambda = \frac{\mu - r}{\sigma}$. A pricing kernel is the product of the risk free discount factor and the Radon-Nikodym derivative for a change of measure form the real world measure to the risk-neutral measure (Schrager, 2002). Under Black-Sholes the pricing kernel is:

$$\begin{aligned} m_t^{BS} &= \exp\left(-\int_0^t r_s ds\right) \frac{d\mathbb{Q}}{d\mathbb{P}}[0,t] \\ &= \exp\left(-\int_0^t r_s ds\right) \exp\left(-\frac{1}{2}\int_0^t \lambda^2 ds - \int_0^t \lambda dW_s^{\mathbb{P}}\right) \\ &= \exp\left(-rt - \frac{1}{2}\left(\frac{\mu - r}{\sigma}\right)^2 t - \left(\frac{\mu - r}{\sigma}\right) W_t^{\mathbb{P}}\right) \end{aligned} \tag{2.3.2}$$

Therefore the stochastic behavior of the pricing kernel under the real world measure $\mathbb{P}$ can be defined as:

$$dm_t^{BS} = -m_t(rdt + \left(\frac{\mu - r}{\sigma}\right) dW_t^{\mathbb{P}}) \tag{2.3.3}$$

Suppose now that a contract is given with time of maturity T and payoff function $F(S_T)$. The value of the contract at time t is given by:

$$F(S_t, t) = E^{\mathbb{P}}\left[m_T^{BS} F(S_T) | S_T = S, m_0 = 1\right] \tag{2.3.4}$$

2.4 Vasicek

In this section the stochastic behavior of the short rate and their corresponding term structure will be explained. An interest rate that is constant over time is very unrealistic and therefore we will introduce stochastic interest rates. In our valuation of sponsor support it is very important that interest scenarios are volatile over time. The fact is, that pension systems are sensitive to interest changes. When interest rates dropped enormously, during the credit crisis, then the market value of liabilities increased and funding ratios dropped.

The stochastic interest rates will be derived according to Vasicek model (Vasicek, 1977). The Vasicek model is a short-term interest rate model since the term structure model completely depends on the short-term interest rate. The stochastic behavior of the short-term interest rate is defined as:

$$dr_t = a(\mu_r - r_t)dt + \sigma_r dW_{rt}^{\mathbb{Q}} \tag{2.4.1}$$

where,

a = mean reversion speed

μ_r = mean reversion level under $\mathbb{Q}$

σ_r = volatility

$W_{rt}^{\mathbb{Q}}$ = Brownian motion under the risk-neutral world measure $\mathbb{Q}$

The model exhibits mean reversion, which means that if the interest rate is less than the mean reversion level $(r_t < \mu_r)$, then the drift, $a(\mu_r - r_t)$, becomes positive so that the rate will be pushed to be closer to the mean reversion level μ_r on average. On the other side, if the interest rate is above the mean reversion level $(r_t > \mu_r)$, then the drift becomes negative so that the rate also will be pushed to the mean reversion level. The mean reversion speed $a > 0$ determines the speed of pushing the interest rate towards its mean reversion level.

However in our simulation we want to generate scenarios under the real world measure $\mathbb{P}$. Therefore we have to combine (2.2.3) and (2.4.1) to derive at the stochastic behavior of the short-term interest rate under the real world measure and can be written in the following way:

$$dr_t = a\left(\left[\mu_r + \frac{\lambda_r \sigma_r}{a}\right] - r_t\right)dt + \sigma_r dW_t^{\mathbb{P}} \qquad (2.4.2)$$

where,

$\mu_r + \frac{\lambda_r \sigma_r}{a}$ = mean reversion level under $\mathbb{P}$

$W_{rt}^{\mathbb{P}}$ = Brownian motion of the interest rate under the real world measure $\mathbb{P}$

We derive the short-term interest rate by applying Itô's lemma to $Y_t = \exp(at)\, r_t$ and becomes:

$$r_t = e^{-at} r_0 + \left[\mu_r + \frac{\lambda_r \sigma_r}{a}\right](1 - e^{-at}) + \sigma_r e^{-at} \int_0^t e^{au} dW_u \qquad (2.4.3)$$

We assume that the bond price depends on the short rate and therefore the value of the zero coupon bond at time t which pays one unit at time T is also known as the discount factor and is defined as:

$$P(t,T) = E_t^{\mathbb{Q}}\left[\exp\left(-\int_t^T r_s ds\right)\right] \qquad (2.4.4)$$

where,

r_s = the short rate at time s

Equation (2.4.4) can be written after some derivations in the following way:

$$P(t,T) = \exp\big(-C(t,T) r_t + D(t,T)\big) \qquad (2.4.5)$$

where,

$C(t,T) = \frac{1 - e^{-a(T-t)}}{a}$ and

$D(t,T) = \left(\left[\mu_r + \frac{\lambda_r \sigma_r}{a}\right] - \frac{\sigma_r^2}{2a^2}\right)[C(t,T) - (T-t)] - \frac{\sigma_r^2 C(t,T)^2}{4a}$

The continuously compounded constant interest rate at time t with time to maturity T is defined in the following way (Schumacher, 2011):

$$R(t,T) = -\frac{1}{T-t}\log\big(P(t,T)\big) \tag{2.4.6}$$

This term structure completely depends on the short rate under Vasicek and after some derivations is of the form:

$$R(t,T) = \left(\left[\mu_r + \frac{\lambda_r\sigma_r}{a}\right] - \frac{\sigma_r^2}{2a^2}\right) + \left(r_t - \left[\mu_r + \frac{\lambda_r\sigma_r}{a}\right] + \frac{\sigma_r^2}{a^2}\right)\frac{1-e^{-a(T-t)}}{a(T-t)} - \frac{\sigma_r^2}{2a^2}\frac{1-e^{-2a(T-t)}}{2a(T-t)} \tag{2.4.7}$$

Therefore at every time t with time to maturity T the interest rate is given according to the Vasicek model.

Subsequently, we have the following stochastic behavior of the bond price:

$$dB_t = R(t,T)B_t dt \tag{2.4.8}$$

where, $R(t,T)$ is the interest rate at time t with maturity T years. We assume that the expected return on stock is constant and uncorrelated with the interest rate. Therefore the stochastic behavior of the stock price is the same as Black-Scholes under $\mathbb{P}$. Furthermore, the assumption induces that the correlation between stocks and bonds is also equal to zero.

With stochastic interest rates the stochastic behavior of the pricing kernel under Vasicek becomes for a given time to maturity T:

$$dm_t^{Vas} = -m_t\left(r_t dt + \left(\frac{\mu_r - r_t}{\sigma_r}\right)dW_{rt}^{\mathbb{P}}\right) \tag{2.4.9}$$

Suppose now that a contract under the Vasicek model is given with time of maturity T and payoff function $F(S_T)$. The value of the contract at time t is given by:

$$F(S_t,t) = E^{\mathbb{P}}[m_T^{Vas}F(S_T)|S_T = S, m_0 = 1] \tag{2.4.10}$$

2.5 Black-Scholes/Vasicek

In this section we combine Black-Scholes and Vasicek, we refer to this as Black-Scholes/Vasicek. Under Black-Scholes/Vasicek the stochastic behavior of the stock price is the same as Black-Scholes under $\mathbb{P}$. The return on bonds is defined in the same way as under Vasicek. Furthermore the stochastic behavior of the liabilities is defined as:

$$dL_t = R(t,T)L_t dt \tag{2.5.1}$$

where, $R(t,T)$ is the interest rate at time t with maturity T years.

We assume that the Brownian motion of the stock price is independent of the Brownian motion of the stock price. Black-Scholes/Vasicek results in the following stochastic behavior of the pricing kernel for a given time to maturity T:

$$dm_t = -r_t m_t dt - \lambda_S m_t dW_{St}^{\mathbb{P}} - \lambda_r m_t dW_{rt}^{\mathbb{P}} = -m_t\left(r_t dt + \lambda_s dW_{St}^{\mathbb{P}} + \lambda_r dW_{rt}^{\mathbb{P}}\right) \qquad (2.5.2)$$

This pricing kernels holds due to the fact that the product processes, $m_t S_t$ and $m_t B_t$, are martingales and as a result, the product process $\{m_t P(t,T)\}$ is a martingale (Charlier et al., 2007).

Chapter 3

Balance sheet of a pension fund: holistic approach

The Call for Advice was mainly about the holistic balance sheet approach. In this chapter this approach will be discussed. First the design of the holistic balance sheet is explained and a comparison between the traditional balance sheet and a holistic approach is made. Thereafter we describe the funding ratio of a pension fund when using the holistic approach. In the last two sections advantages and challenges of the holistic balance sheet approach are given.

3.1 Design holistic balance sheet

In this section we will explain the design of the holistic balance sheet (HBS) and make a comparison between the traditional balance sheet and the HBS. The HBS has the same shape as a traditional balance sheet. The left side contains assets and the right side liabilities and capital[4]. The term holistic indicates that all steering and security mechanisms are included on the balance sheet in the holistic approach. Figure 3.1 shows the differences between the traditional balance sheet and the HBS.

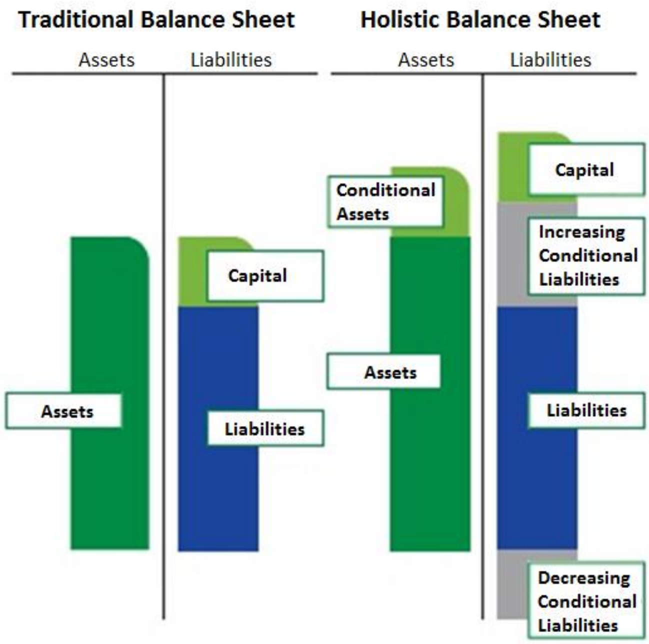

Figure 3.1.1: Traditional Balance Sheet versus Holistic Balance Sheet

[4] In Dutch: Eigen vermogen

The asset side of the HBS is expanded with a new item, which is called conditional assets. Conditional assets include several possibilities. Some possibilities are increasing the premium under certain conditions, sponsor guarantees and general pension guarantee system. By general pension guarantee system you can think of the British Pension Protection Fund. The British Pension Protection Fund takes over pension promises as the sponsor goes bankrupt and the pension fund is underfunded at that moment.

The liabilities side of the HBS is expanded with two items, increasing and decreasing conditional liabilities. In the case of increasing conditional liabilities we can think of conditional indexation and future accrual. An example of decreasing conditional liabilities is cutting pensions.

The conditional items on the HBS should be calculated market consistent in principle. This means that the value of the items should as far as possible a true reflection of the value when it should be traded on the free market. Most of conditional items have certain assumptions. For example a sponsor guarantee which only pays if the funding ratio is below 95% or conditional indexation which is only paid if the funding ratio is above 110%. As a result, these items have the same characteristics as options.

3.2 Funding ratio holistic balance sheet

The idea behind the HBS is that such a balance sheet provides a more complete view of the total financial position of a pension fund. An indicator of the financial position of a pension fund is the funding ratio of that pension fund. The funding ratio of pension fund is the ratio of assets to its liabilities. In case of HBS, the asset side consists of assets and conditional assets and the liabilities side can be divided into liabilities, increasing and decreasing conditional liabilities. In formula the funding ratio is defined as:

$$FR = \frac{value\ of the\ assets}{value\ of\ the\ liabilities} \qquad (3.2.1)$$

A funding ratio above 100% indicates that the pension fund is able to cover all payments it is obligated to make. While a funding ratio below 100% indicates that the pension fund is underfunded. In that case the pension fund is either unable to make payments or is in danger of not being able to do so.

When we compare two pension funds with the same funding ratio, then we can suppose that a pension fund with sponsor guarantees has a better position than a pension fund without such sponsor guarantees. It might follow that the required capital buffers for a pension fund with sponsor guarantees are reduced. The pension fund with sponsor guarantees needs less capital buffers to pay with the same certainty a particular pension.

3.3 Advantages holistic balance sheet approach

In this section some advantages of the HBS approach are given. The HBS gives a completer view of the real situation of a pension fund. As a result, it is possible to compare pension funds with different pension systems and different steering and security mechanisms. Furthermore the Groupe Consultatif thinks that the HBS results in better risk management and better information to stakeholders (Bosch, van den, and Valkenburg, 2012). This fulfils the desire of the European Commission to monitor all pension systems with a harmonized supervisory framework. In this way the difference between insurers and pension funds can be made.

3.4 Challenges holistic balance sheet approach

In this last section, we give some challenges of the HBS approach. There are some implementations problems. First of all, the calculation of conditional items is complex. There exist hardly any standard formulas to calculate these conditional items and steering mechanisms are not always direct observable. The valuation models looks like more complex ALM-models, such that more assumptions and specific expertise are needed. This will raise the costs for pension funds. Larger pension funds can maybe realize the extra costs, but for smaller pension funds the extra costs can be a big problem. Furthermore the HBS has added value for funded systems and pension systems with guarantees where often steering instruments are present, but less for other pension systems. An example is defined contribution, that requires no additional steering instruments. In that case the HBS looks like a traditional balance sheet. At least the HBS can lead to pseudo-security, since pension funds can maybe invest more risky than before introducing the HBS.

Chapter 4

Sponsor support

In the previous chapter we have discussed the holistic balance sheet approach. The asset side of the HBS consists of assets and conditional assets. An example of conditional assets is sponsor support. In this thesis we focus on this conditional asset. In this chapter, first we give the definition of sponsor support by EIOPA. Thereafter we describe our definition of sponsor support. Finally in order to value sponsor support in Chapter 5 and 6, the assumptions of sponsor support will be given.

4.1 Definition

In EIOPA's advice on the review of the IORP Directive sponsor support can be distinguished in four forms (EIOPA, 2012):

1. Increases in contributions
2. Subsidiary liability of the sponsor
3. Contingent assets of the sponsor
4. Claims on the sponsor

All forms can be valued by estimating the future cash flows of the sponsor. In Form 1 these future cash flows are paid to the IORP and in Form 2 there are payments to members and beneficiaries. Form 3 are the assets who are still in possession of the sponsor at the accounting date, but can flow to the pension fund under a predefined set of circumstances. Form 4 relates to claims on the sponsor on discontinuance of the IORP. In essence this form of sponsor support is what would be available to the IORP if the link between the IORP and the sponsor is broken. In the review of the IORP Directive IORPs should recognize the value of sponsor support, regardless of the Form, as an asset on the holistic balance sheet.

In this thesis we define sponsor support as form 3. A sponsor enters into a contract with a pension fund to pay an additional payment under certain conditions. In the Netherlands, this kind of contracts exists already (Rijksoverheid, 2011). A condition can be that the sponsor only pays at a certain time if the funding ratio is below a minimum funding ratio. The funding ratio, in case of sponsor support, is the ratio of assets plus sponsor support, in other words value of the assets after additional payments by the sponsor, to its liabilities. In formula the funding ratio is defined as:

$$FR^{+} = \frac{VA^{+}}{VL} = \frac{value\ of\ the\ assets\ \ after\ additional\ payments}{value\ of\ the\ liabilities} \quad (4.1.1)$$

Sponsor support at time t is equal to the discounted difference between value of the assets after additional payments and before additional payments by the sponsor. We assume that the sponsor never gets payments back from the pension fund. In formula sponsor support at time t, SS_t, is:

$$SS_t = m_t * (VA_t^{+} - VA_t) * 1_{FR_t < minFR} \quad (4.1.2)$$

where,

m_t = pricing kernel in relevant market

VA_t^{+} = value of the assets after additional payments by the sponsor

VA_t = value of the assets before additional payments by the sponsor

FR_t = funding ratio at time t

$minFR$ = minimum funding ratio

As a result, the funding ratio after the additional payment is at most equal to the minimum funding ratio at every time t.

Sponsor support in a scenario is the sum of sponsor support at every time step t. Subsequently, total average sponsor support is the average of all these scenarios. In formula total average sponsor support is defined as:

$$Sponsor\ support = E^{\mathbb{P}}\left[\sum_{t=1}^{T}\left(m_t * (VA_t^{+} - VA_t) * 1_{FR_t < minFR}\right)\right] \quad (4.1.3)$$

4.2 Assumptions

In order to value sponsor support in the next chapters, the circumstances have to be equal for the methods we will use. In this section the assumptions of sponsor support will be given.

The following assumptions are made and applied to all methods that will be simulated:

- The minimum funding ratio is 105%. This value is according to the Dutch central bank (Hereafter DNB[5]), since the DNB requires a minimum funding ratio of 105%.
- The agreement is made for a period of 5 years.
- Sponsor has unlimited resources to make additional payments to the pension fund.
- Sponsor never gets payments back from the pension fund.

[5] In Dutch: De Nederlandsche Bank

Chapter 5

Valuing sponsor support under Black-Scholes/Vasicek

The aim of this chapter is to value sponsor support in the real world using Black-Scholes and the Vasicek model. Hereafter we will refer to this simply as Black-Scholes/Vasicek. First we give a description of Black-Scholes/Vasicek. Then we will describe the data and define the input parameters of several different variables and which asset mix we use. Thereafter we simulate 10,000 scenarios and determine the possible sponsor payments. Finally we will give the results of our simulation.

5.1 Description Black-Scholes/Vasicek

Black-Scholes/Vasicek is as already mentioned a combination of the Black-Scholes model and the Vasicek model. The combination of these two models is explained in Paragraph 2.5. In this chapter we use the stochastic behavior of the stock price, the stochastic behavior of the short-term interest rate and the stochastic behavior of the pricing kernel.

Furthermore we assume a portfolio of bonds with a duration of 10 years. Then the stochastic behavior of the bond price can be written as Equation 2.4.7 with a duration of 10 years and is defined by:

$$dB_t = R(t,10)B_t dt \tag{5.1.1}$$

We want to use as much as possible the same data under Black-Scholes/Vasicek as under MoSes. In the next chapter we make a distinguish between two pension funds. One pension fund has a benefit stream of liabilities with a duration of approximately 15 years and the other one has a duration of approximately 20 years. We will mention in Chapter 6 that we will use the pension fund with a duration of 15 years for comparison. As a result, the stochastic behavior of the liabilities can be written as Equation 2.5.1. with a duration of 15 years and is defined by:

$$dL_t = R(t,15)L_t dt \tag{5.1.2}$$

The Black-Scholes/Vasicek model can generate real world scenarios, because we are under $\mathbb{P}$. These scenarios describing interest rates, stock and bond returns and the pricing kernel.

5.2 Parameter choices

Before we can start simulating, we have to define the input parameters of several different variables. These parameter values can be found in Tables 5.2.1-5.2.4. These values are chosen in such a way that they reflect the real world in the best possible way in order to produce relevant results. As described in Chapter 4 the sponsor makes payments for 5 years. Furthermore in Chapter 4 the minimum funding ratio and the initial value of the pension fund is set. Next we have to choose the financial market parameter values and their initial values. The parameter values of the stock are according to the default parameters of Tilburg Finance Tool (Werker, 2011). We assume constant interest rate is equal to 3%. We want to use as much as possible the same data under Black-Scholes/Vasicek as under MoSes. Therefore the mean reversion and the return volatility is set such as the values used under MoSes and the short rate is equal to the short rate at 31-12-2011. The mean reversion level is according to data from the DNB of the past 12 years.

Parameter		Value
Years Sponsor Support	T	5
Minimum funding ratio	$minFR$	1.05

Table 5.2.1: Parameter values

Parameter		Value
Initial funding ratio	FR_0	1.05

Table 5.2.2: Initial parameter value pension fund

Parameter		Value
Expected return on stock	μ_S	0.08
Stock volatility level	σ_S	0.2
Interest rate	r	0.03
Mean reversion speed	a	0.0246
Mean reversion level of interest rate	$\mu_r + \lambda\sigma_r/a$	0.04
Interest rate volatility level	σ_r	0.0098

Table 5.2.3: Parameter values financial market

Parameter		Value
Initial short rate	r_0	0.01544

Table 5.2.4: Initial parameter value financial market

We use the strategic asset mix instead of the actual asset mix, since the actual asset mix is just the asset mix at one particular moment in time while the strategic asset mix is the target asset mix of the fund. The strategic asset mix is stated in Table 5.2.5. We assume that pension funds rebalance their asset mix every year such that the weights of the portfolio remains the same.

Asset	Mix
Stocks	40%
Bonds	60%

Table 5.2.5: Strategic asset mix of the pension fund

5.3 Simulation

Now that we have the data we need, we can simulate the possible developments of assets and liabilities. In order to simulate the possible developments of assets and liabilities, we apply Monte Carlo simulations and run the model 10,000 times. The simulations are done with the mathematical program Matlab[6]. Matlab simulates 10,000 times the return for assets and liabilities. These returns are used to simulate returns on funding ratios. Furthermore using the initial funding ratio and the return on funding ratios, we can examine future funding ratios. When a future funding ratio is below the minimum funding ratio then an additional payment by the sponsor will occur. On a result, the funding ratio after this additional payment is always at most equal to the minimum funding ratio.

5.4 Results

In Chapter 4 we assumed that the minimum funding ratio should be equal to 105%. We will use this minimum funding ratio as the starting value of the funding ratio. Therefore there is no additional payment by the sponsor right now. As expected, after simulating the Black-Scholes/Vasicek model we find that there will be funding ratios below 105%. So there can be additional sponsor payments from year 1. We can illustrate this by a histogram of possible funding ratios 1 year from now, which is stated in Figure 5.4.1.

[6] The Matlab code can be obtained on request.

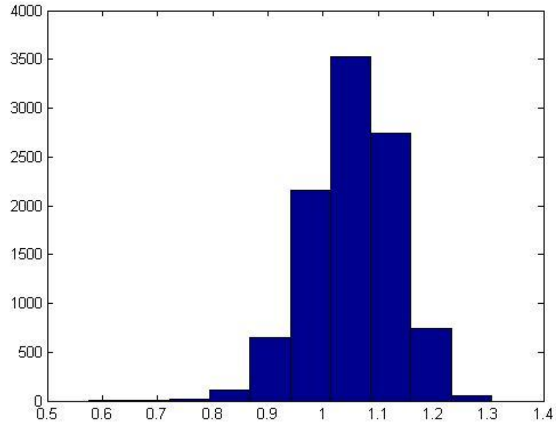

Figure 5.4.1: Histogram of possible funding ratios 1 year from now

Not in every scenario there will be sponsor support. We find that from year 1, every year sponsor support occurs in less scenarios. The exact values of how many times sponsor support occurs are stated in Table 5.4.1. On average, the discounted additional payment by the sponsor is about 3.6% of liabilities per year, see Table 5.4.2. However we found that sponsor support varies a lot and can be much more than 3.6% in a year. In year 1 the 90% Value-at-Risk is 14.0%, such that sponsor support can be in 90% of the cases 14.0% or less. This is a large difference with the average sponsor support in year 1 and therefore this risk must be hedged. Furthermore we find that a sponsor has to pay the largest part in year 1 and thereafter sponsor support decreases per year.

Initial value funding ratio	**How many times sponsor support (in %)**						
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	**Total**
105%	0	45.7	34.1	28.4	24.4	22.6	73.1

Table 5.4.1: How many times sponsor support occurs (in %) in a year and in total

with initial funding ratio 105%

Initial value funding ratio	**Sponsor Support (in % of liabilities)**						
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	**Total**
105%	0 [0.0 , 0.0]	4.3 [0.0 , 14.0]	3.6 [0.0 , 12.5]	3.5 [0.0 , 11.7]	3.3 [0.0 , 10.7]	3.3 [0.0 , 10.5]	18.1 [0.0 , 47.1]

Table 5.4.2: Market-consistent value of sponsor support (in % of liabilities)

with initial funding ratio 105%

In total, we find that in 73.1% of the cases an additional sponsor payment will take place. On average the total additional sponsor payment can be 18.1% of liabilities. Furthermore we find that the average sponsor support in total varies a lot. The corresponding 80%-confidence interval shows that the sponsor additional payment can be much larger than 18.1%. The 90% Value-at-Risk is 47.1%, such that the additional sponsor payment can be in 90% of the cases 18.1% or less. As a result this risk must be hedged.

As mentioned earlier in this thesis contracts like sponsor support exist in the Dutch pension fund world. One pension fund has to deal with sponsor support, while other pension funds have no sponsor guarantees. An advantage of the IORP II Directive on Dutch pension funds is that pension funds can be better compared and that’s providing harmonization of monitoring. In this way sponsor support is included in the solvency requirement. A pension fund with sponsor support has less solvency requirements than a pension fund without sponsor support. We mentioned already that on average total sponsor support can be 18.1% of liabilities. The annual report of Philips (2011) shows that the liabilities are approximately 20 billion, such that sponsor support can be approximately 4 billion. The annual report also shows that the profit of Philips is normally about 1 billion, this implies that sponsor support is four times the profit. Therefore sponsor support can be a significant amount if a funding ratio of 105% is ensured by the sponsor and can be an important asset on the HBS. Most sponsors don’t have the resources of four times the profit, therefore it will be a hard task for the sponsor to ensure this minimum funding ratio. Geraldine Leegwater (2011), Head of Investment Communications Stichting Pensioenfonds of ABN AMRO Bank, said that sponsors are less and less willing to take risks. If sponsors know beforehand that sponsor support will be a significant amount to ensure a minimum funding ratio then in the future this kind of contracts may be modified or may even disappear.

Chapter 6

Valuing sponsor support under MoSes

In this chapter we will value sponsor support in the risk-neutral world using the risk-neutral economic scenario set which has been developed by Towers Watson. This risk-neutral economic scenario set is generated by MoSes Economic Scenario Generator (hereafter: MoSes ESG). First we give a description of MoSes. Then we will describe the data and define the input parameters of several different variables and which asset mix we use. Thereafter we simulate 1,000 scenarios and determine the possible additional sponsor payments for two different pension funds. Finally, we will give the results of our simulations for both pension funds and end the section with a comparison between these pension funds.

6.1 Description MoSes

MoSes ESG is a modeling application that enables us to project market-consistent economic scenarios describing interest rates, corporate bond spreads, stock and property returns, and other asset prices. In stochastic financial models, scenarios allow replication of current market prices and are arbitrage-free in a risk-neutral setting. These scenarios reflect the expected returns and volatilities implied by current market conditions.

Input for the MoSes ESG is market prices. Furthermore the Hull-White model, also known as the extended Vasicek model, is used to model interest rates and index assets, for example equities and properties, can be modeled using Geometric Brownian Motion with a stochastic interest rate.

The MoSes ESG can generate scenarios with appropriate market-consistent statistical properties that will enable us to reduce the number of scenarios required to achieve the accuracy we need. This means that we can use fewer scenarios in our financial models to reduce run time without compromising accuracy.

6.2 Parameter choices

Since we cannot generate a risk-neutral economic scenario set ourselves, we are dependent on the data which Towers Watson puts into the model. As a result, we cannot use the exact same data as input as we did in the real world model. We try to use similar data as much as possible.

The risk-neutral economic scenario set is calibrated to the swap curve at 31-12-2011 with the following parameters:

Parameter		Value
Mean reversion	a	0.0246
Volatility	σ_r	0.0098

Table 6.2.1: Parameter values financial market

Furthermore we use mostly the same input parameters as under Black-Scholes/Vasicek. These input parameters are the number of years a sponsor make additional payments, the minimum funding ratio and the initial funding ratio.

We determine sponsor support for two different pension funds. From the supervisor of Towers Watson we received two benefit streams of liabilities for two different pension funds. Pension fund 1 is a small, simple pension fund with a duration of approximately 15 years. While pension fund 2 is a big, complicated pension fund with a lot of liabilities and a duration of approximately 20 years. We assume that these pension funds are constant pension funds. By this we mean that what is paid to liabilities is also built up in the same year.

6.3 Simulation

From the Investment Department of Towers Watson we received a risk-neutral economic scenario set with 1,000 simulations for the short rate, different nominal rates and the equity index over a 40 year horizon. We use the same asset mix as we did in the real world model. The asset mix is stated in Table 5.2.5. We first use the equity index to generate returns on stocks. Just as in case of Black/Scholes-Vasicek, we use a portfolio of bonds with duration 10. To simulate 1,000 times the return on funding ratios we still need returns on liabilities. We use the nominal rates and the benefit streams to generate the return on liabilities. Finally we use the nominal rates to generate the discounted value factor. Thereafter we value sponsor support in the same way as under Black-Scholes/Vasicek. We use Monte-Carlo simulation to simulate 1,000 times the return on funding ratios. These simulations are done with the mathematical program Matlab[7]. The return on funding ratios together with the initial funding ratio take care of a potential additional payment. We have to mention again that whenever an additional payment by the sponsor occurred, the funding ratio at that moment becomes every time the minimum funding ratio.

[7] The Matlab code can be obtained on request.

6.4 Results

As already stated in Section 6.2 we determine sponsor support for two different pension funds. In this section, first we show the results for pension fund 1 and after that for pension fund 2. We end this section with a comparison between pension fund 1 and pension fund 2.

6.4.1 Pension fund 1

Just like in the real world we start with a funding ratio which is the same as the minimum funding ratio. Therefore the sponsor has nothing to pay right now. As expected, after simulating under MoSes it turns out that there will be funding ratios below 105% in the following years. So there can be additional sponsor payments from year 1. To illustrate this a histogram of possible funding ratios 1 year from now is stated in Figure 6.4.1.1.

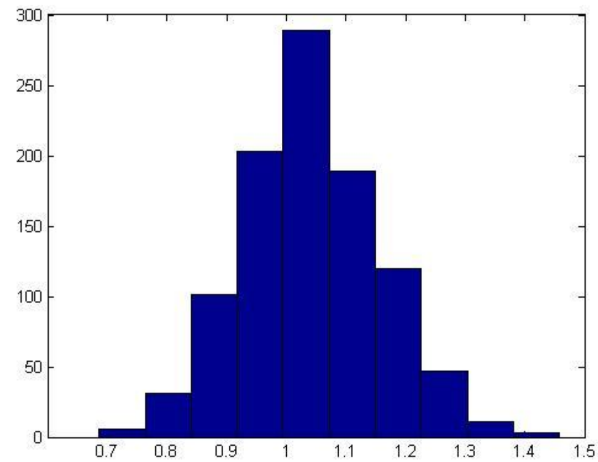

Figure 6.4.1.1: Histogram of possible funding ratios 1 year from now for pension fund 1

Not in every scenario there will be sponsor support. We find that from year 1, every year occurs in approximately half of the cases sponsor support. The exact values are stated in Table 6.4.1.1. On average, the discounted additional payment by the sponsor is about 4.3% of liabilities per year, see Table 6.4.1.2. However we found that sponsor support varies a lot and can be much more than 4.2% in a year. In year 1 the Value-at-Risk is 16.8%, such that sponsor support can be in 90% of the cases 16.8% or less. This is a large difference with the average sponsor support in year 1 and therefore this risk must be hedged. Furthermore we find a structure in the additional sponsor payment, the additional payments by the sponsor are the largest in year 1 and afterwards these payments decrease with exception of year 5 where we find a little increase.

In total, we find that in 82.4% of the cases sponsor support occurs. On average the additional sponsor payment is 20.9% of liabilities. Furthermore we find that average total sponsor support varies a lot. Therefore it can be that sponsors additional payment is much larger than 20.9%. The 80%-confidence interval shows that sponsor support can be much larger than 20.9%. The 90% Value-at-Risk is 49.6%, such that the additional sponsor payment can be in 90% of the cases 49.6% or less. As a result this risk must be hedged.

Initial value funding ratio	**How many times sponsor support (in %)**						
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	**Total**
105%	0	55.0	40.3	36.1	32.8	31.4	82.4

Table 6.4.1.1: How many times sponsor support occurs (in %) in a year and in total with initial funding ratio 105% for pension fund 1

Initial value funding ratio	**Sponsor support (in % of liabilities)**						
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	**Total**
105%	0.0 [0.0 , 0.0]	5.5 [0.0 , 16.8]	4.4 [0.0 , 15.6]	4.2 [0.0 , 15.7]	3.3 [0.0 , 12.5]	3.5 [0.0 , 13.6]	20.9 [0.0 , 49.6]

Table 6.4.1.2: Sponsor support (in % of liabilities) per year and in total with initial funding ratio 105% for pension fund 1

6.4.2 Pension fund 2

We start again with a funding ratio which is the same as the minimum funding ratio, such that sponsor payment right now is equal to zero. As expected, we found after simulating under MoSes funding ratios below 105% in the following years. Therefore there can be sponsor payments from year 1. To illustrate this a histogram of possible funding ratios 1 year from now is stated in Figure 6.4.2.1.

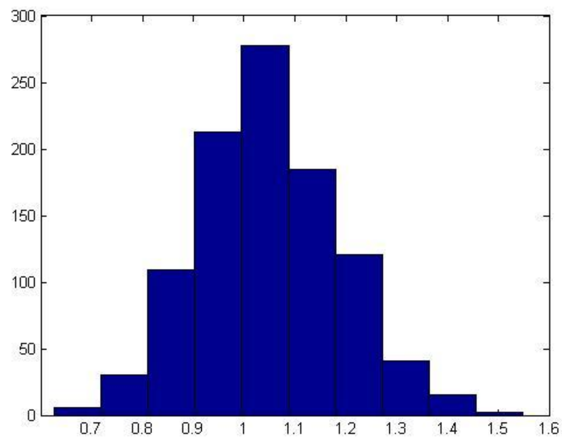

Figure 6.4.2.1: Histogram of possible funding ratios 1 year from now for pension fund 2

Sponsor support will not occur in every scenario. From year 1, sponsor support will be occur approximately in 52% of the cases. The values per year are stated in Table 6.4.2.1. On average, the discounted additional payment by the sponsor is about 4.8% of liabilities per year which is stated in Table 6.4.2.2. However sponsor support can be much more than 6.3% in a year, since it varies a lot. In year 1 the 90% Value-at-Risk is 19.6%. Therefore sponsor support can be in 90% of the cases 19.6% or less and this risk must be hedged. Furthermore we find a structure in the additional sponsor payment, in year 1 the additional sponsor payments are the largest thereafter the payments decrease with exception of year 5 where we find a little increase.

In total, in 79.2% of the cases occurs sponsor support. On average the additional sponsor payment is 24.2% of liabilities. Furthermore we find that sponsor support varies a lot. Therefore it can be that sponsors additional payment is much larger than 24.2%. The 80%-confidence interval shows that the sponsor additional payment can be much larger than 24.2%. The 90% Value-at-Risk is 59.3%, such that in 90% of the cases sponsor support can be 59.3% or less. As a result this risk must be hedged.

Initial value funding ratio	**How many times sponsor support (in %)**						
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	**Total**
105%	0	52.0	38.6	33.7	28.8	28.1	79.2

Table 6.4.2.1: How many times sponsor support occurs (in %) in a year and in total with initial funding ratio 105% for pension fund 2

Initial value funding ratio	**Sponsor support (in % of liabilities)**						
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	**Total**
105%	0.0 [0.0 , 0.0]	6.3 [0.0 , 19.6]	5.1 [0.0 , 18.4]	5.0 [0.0 , 18.9]	3.8 [0.0 , 14.3]	4.0 [0.0 , 15.0]	24.2 [0.0 , 59.3]

Table 6.4.2.2: Sponsor support (in % of liabilities) per year and in total with initial funding ratio 105% for pension fund 2

6.4.3 Pension fund 1 versus pension fund 2

Comparing pension fund 1 with pension fund 2 we find a small difference in sponsor support between the two pension funds. The difference in sponsor support is mainly due to duration of the two pension funds. Pension fund 2 has a higher duration. Since the observed difference is small, we only discuss pension fund 1 further in this thesis.

An advantage of the IORP II Directive on Dutch pension funds is that pension funds can be better compared and that's providing harmonization of monitoring, because we know that contracts like sponsor support exist in the Dutch pension fund world. In this way sponsor support can be included in the solvency requirement. On average, the additional sponsor payment in pension fund 1 is 20.9% of liabilities. If we look again to the annual report of Philips (2011) sponsor support can be approximately four times the profit. Therefore sponsor support can be a significant amount if a funding ratio of 105% is ensured by the sponsor and can be an important asset on the HBS. Most sponsors don't have the resources of four times the profit, therefore it will be a hard task for the sponsor to ensure this minimum funding ratio. Furthermore, the same argument as in Chapter 5, that sponsors are less and less willing to take risk, holds. Therefore if sponsors know beforehand that sponsor support will be a significant amount to ensure a minimum funding ratio then in the future this kind of contracts may be modified or may even disappear.

Chapter 7

Sensitivity Analysis

In this chapter, we will investigate the sensitivity of the model. We will start with a sensitivity analysis on the impact of different financial markets. Secondly, we will look at different initial values of the pension fund. Next we will investigate the impact of policy of a pension fund, like asset mix, cutting pensions and indexation. Finally, the impact of different initial values of the financial market will be performed. The tables corresponding to the sensitivity analyses can be found in Appendix A. It has to be noticed that we will look to different initial funding ratios in all of the sensitivity analyses. Furthermore only the topic of the analyses will change and all other parameters remain the same.

7.1 Black-Scholes/Vasicek versus MoSes

In this thesis we look at sponsor support in two different financial markets, Black-Scholes/Vasicek and MoSes. Via Equation 2.2.1 we know that if you change measures and use the Radon-Nikodym derivative under $\mathbb{P}$, then the price in the real world is equal to the price in the risk-neutral world. This implies that sponsor support under Black-Scholes/Vasicek should be equal to sponsor support under MoSes. However, as we already mentioned we cannot use the exact same data as input under Black-Scholes Vasicek and MoSes. Furthermore under MoSes we take into account fluctuating long-term rates, while under Black-Scholes/Vasicek the long-term rate is not volatile. Therefore there is a difference visible. Changing the initial funding ratio takes care of the same movements of sponsor support under both methods. Since under MoSes we include fluctuating long rates we use for almost the rest of the sensitivity analyses MoSes. Except for the sensitivity analysis on the short rate, because we can only change the initial short rate under Black-Scholes/Vasicek.

7.2 Initial funding ratio

In this section we will perform a sensitivity analysis on different initial funding ratios. We will decrease the initial funding ratio from 105% to 90% and afterwards we will increase it from 105% to 120%.

If the initial funding ratio is changed to 90% we find that sponsor support is increased by approximately 15%. This is a logical increase, since a sponsor only pays if the funding ratio is below a minimum funding ratio. In this thesis the minimum funding ratio is assumed 105%. Immediately in the first year the sponsor made a payment. This payment will be equal to the difference of the minimum funding ratio and the initial funding ratio. Therefore the payment in the first year becomes immediately 15%. In particular if the initial funding ratio is decreased from the minimum funding ratio with a certain percentage, then sponsor support will increase with the same percentage.

Subsequently, the initial funding is changed to 120%. Not surprisingly sponsor support decreases. This is due to the fact that when we start with a higher initial funding ratio, the chance that a funding ratio drops below the funding ratio further in time becomes smaller.

7.3 Asset mix

The first impact of policy of pension fund we will investigate is asset mix. In this section we will investigate several asset mixes, which are stated in Table 7.3.1.

Asset	Mix 1	Mix 2	Mix 3	Mix 4
Stocks	10%	40%	60%	90%
Bonds	90%	60%	40%	10%

Table 7.3.1: Asset mixes for sensitivity analysis

Figure 7.3.1 shows the results of sponsor support of the different asset mixes. From this figure we can conclude that sponsor support increases when the percentage stocks in the asset mix increases. This is due to the fact that stocks are on average more volatile than bonds. That stocks generate higher returns than bonds on average is related to the more volatility of stocks. If there is more volatility the probability of ending up below the minimum funding ratio will be higher, such that sponsor support increases. Another point what could happen when there is more volatility is that the loss in a specific scenario will be larger. Furthermore higher initial funding ratio results in lower sponsor support.

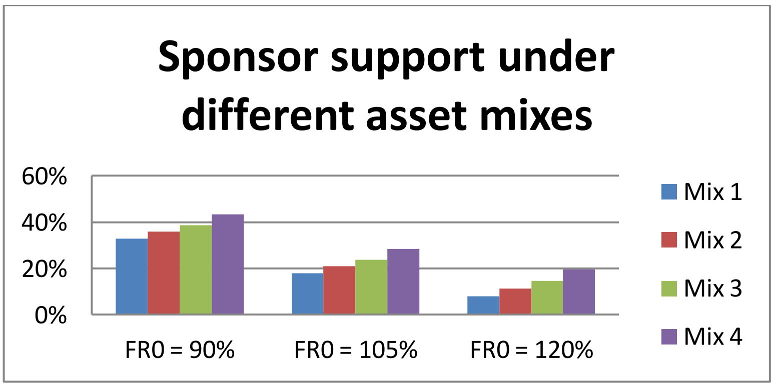

Figure 7.3.1: Sponsor support under different asset mixes

7.4 Cutting pensions

The second impact of policy of the pension fund we will investigate is cutting pensions. In this section a sensitivity analysis on cutting pensions is performed. In this thesis cutting pensions[8] is defined in the first way as cutting of pensions with a maximum of 7 percent, each year, to recover the funding ratio to the minimum funding ratio. We can split up in three possibilities:

1. $FR > 105\%$: no cutting pensions, no sponsor support
2. $\frac{105}{107} * 100\% < FR < 105\% \Leftrightarrow 98.1\% \leq FR \leq 105\%$: participant linear cutting of 0 to 7 percent, no sponsor support
3. $FR < 98.1\%$: 7 percent cutting, rest sponsor support

In this case participants bears almost all risk and the sponsor only comes in when there is a very low funding ratio.

We don't want all risk to go to the participant, so we introduce a second definition of cutting pensions. We want to share the risk between participant and sponsor in a 50-50 way. This means that 50 percent of the risk lies with the sponsor and the other 50 percent lies with the participant. For example if the funding ratio has to increase by 1 percent, then the participant is cut by 0.5 percent and the assets increase by the same percentage.

In this case, we have the following possibilities:

1. $FR > 105\%$: no cutting pensions, no sponsor support
2. $\frac{105}{107/93} * 100\% < FR < 105\% \Leftrightarrow 91.3\% \leq FR \leq 105\%$: participant and sponsor equal linear spread of 0 to 7 percent
3. $FR < 91.3\%$: 7 percent cutting, rest sponsor support

After analyzing the results, the first thing that stands out is when we have an initial funding ratio of 105% the division sponsor-participant is almost 50-50. For the division of sponsor-participant see Table 7.4.1. Secondly, after changing the initial funding ratio to a lower funding ratio and to a higher funding ratio, it is notable that proportion of participant decreases as funding ratio increases. This is due to the case that when we start in a lower funding ratio, the probability of a funding ratio below 91.3% is bigger than when we start in a higher funding ratio. If the funding ratio is below 91.3% the participant is always cut by 7 percent and the rest is paid by the sponsor. The rest part is bigger when we start in a lower initial funding ratio, then when we start in a higher initial funding ratio. Therefore the participant will be cut more/less in a lower/higher initial funding ratio. Finally, per initial funding ratio sponsor support decreases approximately half, see Figure 7.4.1.

[8] In Dutch: Afstempelen

If we change the maximum percentage of cutting first to 3% and afterwards to 15% we find that this maximum cutting value is important for the sponsor. When the pensions will be cut less/more, sponsor support will be more/less. Furthermore higher initial funding ratio takes care of lower sponsor support and lower initial funding ratio takes care of higher sponsor support.

Max percentage cutting	Initial funding ratio 90%	Initial funding ratio 105%	Initial funding ratio 120%
7%	48.7-51.3	50.6-49.4	51.2-48.8
3%	72.0-28.0	69.2-30.8	68.8-31.2
15%	43.1-56.9	44.3-55.7	45.2-54.8

Table 7.4.1: Division sponsor-participant

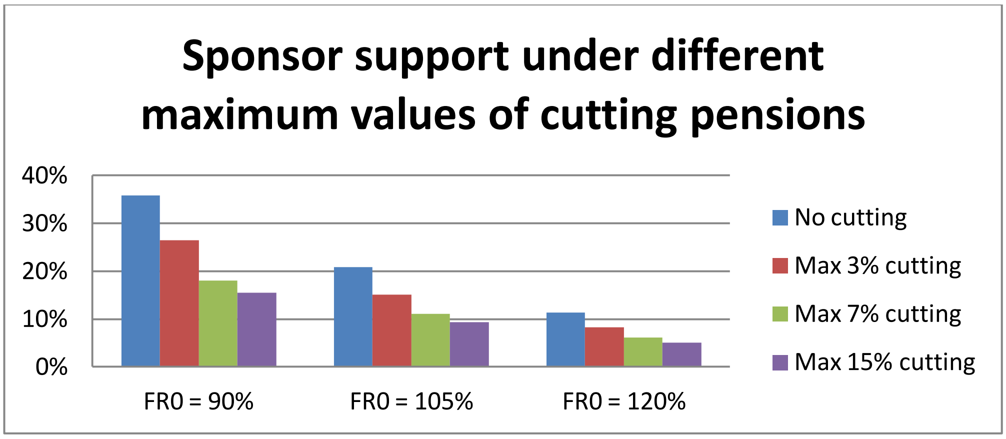

Figure 7.4.1: Sponsor support under different maximum values of cutting pensions

7.5 Indexation

The last impact of policy of the pension fund we will investigate is indexation. In this section a sensitivity analysis on indexation will be performed. We define indexation as an increase in pensions. This increase in pensions does not happen always, pensions only increases if the financial resources of a pension fund permit. Pensions are indexed to inflation, 2.4% in 2011 (Centraal Bureau voor de Statistiek, 2012). We assume that pension can increase by a maximum of 2.4%. We can distinguish three possibilities:

1. $FR > 125\%$: indexation of 2.4%, no sponsor support
2. $110\% < FR < 125\%$: linear indexation of 0 to 2.4%, no sponsor support
3. $105\% < FR < 110\%$: no indexation, no sponsor support
4. $FR < 105\%$: sponsor support

Indexation has no impact if the initial funding ratio is below 110%, because then there will be little indexation and sponsor support remains approximately the same. When the initial funding ratio is above 110% the probability of higher future funding ratios is larger, such that there can be more indexation which the sponsor pays.

Changing the inflation from 2.4% to 10% results also in no impact if the initial funding ratio is below 110%. Above 110% it results in more sponsor support, because the pensions increase.

7.6 Short rate

In this final section a sensitivity analysis on the short rate is performed. First of all the short rate will be decreased from 1.544% to 0.5%, subsequently the short rate will be increased to 5%.

A decrease in the short rate will have no impact on the sponsor support. Only a big increase of the short rate results in an impact for sponsor support. It also has to be noticed that different short rates behave the same over different initial funding ratios. By this we mean that as the initial funding ratio increases sponsor support decreases. Therefore initial funding ratio and sponsor support are opposites.

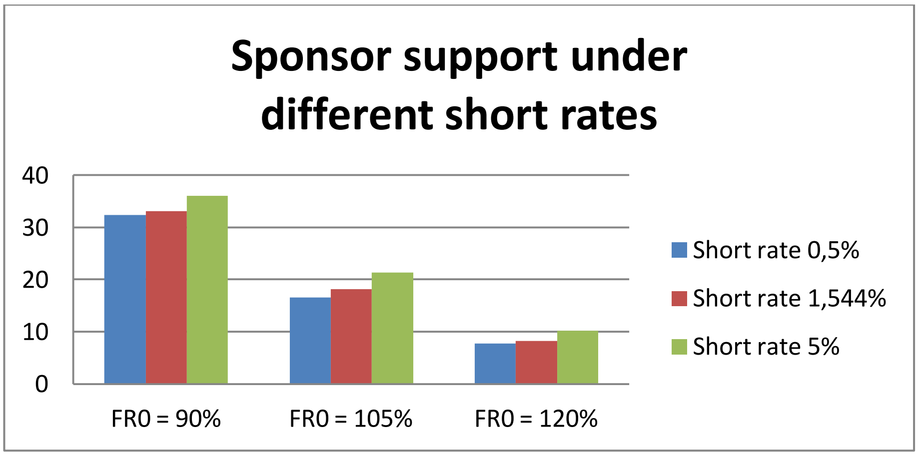

Figure 7.6.1: Sponsor support under different short rates

Chapter 8

Conclusion & Recommendations

In this final chapter our conclusions and recommendations for further research will be given. The conclusions will be based on the results from Chapter 5 and 6 and the performed sensitivity analysis of Chapter 7. Furthermore we will have two discussions. One discussion is about the initial idea of introducing the holistic balance sheet approach and thereafter we will discuss the IORP II Directive in general. The last section provides some recommendations for further research which are derived from this thesis.

8.1 Conclusions

In this thesis we investigated the following research question:
"What are the consequences applying sponsor support valuation according to the IORP II Directive to Dutch pension funds?"

Adapting the standard models
After adapting the standard models, we found under Black-Scholes/Vasicek that sponsor support can be 18.1% of liabilities for our pension fund. In general this is a significant amount for a sponsor to pay as additional payment. An advantage of the IORP II Directive on Dutch pension funds is that pension funds with different pension systems and different steering and security mechanisms can be better compared. Another advantage is that it provides harmonization of monitoring. In this way sponsor support can be included in the solvency requirement. Sponsor support can be a significant amount if a minimum funding ratio is ensured by the sponsor and can therefore be an important asset on the holistic balance sheet. Most sponsors haven't those resources of four times the profit in case of Philips, therefore it will be a hard task for the sponsor to ensure this minimum funding ratio. Moreover, in the future this kind of contracts may be modified or may even disappear.

Under MoSes we apply two pension funds. We found that sponsor support is on average 20.9% and 24.2% of liabilities for respectively pension fund 1 and pension fund 2. The difference in sponsor support is mainly due to duration of the two pension funds, because pension fund 2 has a higher duration. Since the observed difference is small, we only discussed pension fund 1 in this thesis with keeping in mind the observed difference. Under MoSes sponsor support is again a significant amount for a sponsor to pay as additional payment. Therefore the same consequences as under Black-Scholes/Vasicek applying sponsor support valuation according to the IORP II Directive to Dutch pension funds holds under MoSes.

Sensitivity analysis

In the sensitivity analysis we analyzed the impact of different financial markets. The observed differences between the different financial markets are small. However the model under MoSes is a better model, since we include fluctuating long rates. Therefore we use for the largest part of the sensitivity analyses MoSes as basis.

Secondly, we have investigated the impact of different initial funding ratios. Decreasing the initial funding ratio from 105% to 90% results as expected in higher sponsor support. Consequently it will be even more difficult for the sponsor to ensure a minimum funding ratio. If we start with a higher initial funding ratio of 120%, then sponsor support will be 11.4%. This is much smaller than in case of an initial funding ratio of 105% and is approximately halved. This results in less resources for the sponsor after applying sponsor support according to the IORP II Directive to Dutch pension funds.

Furthermore, in the sensitivity analysis we investigated impact of policy of pension fund. The first impact is asset mix. When the percentage stocks in asset mix decreases, sponsor support also decreases. Furthermore if the initial funding ratio increases, then sponsor support decreases. For example if the asset mix is 10-90 (stocks-bonds) with an initial funding ratio of 120%, then sponsor support will be 8.0%. Consequently it depends on the percentage stocks and the initial funding ratio whether there are more or less disadvantages. If we have an asset mix with a low percentage stocks and a high initial funding ratio, then sponsors need less resources.

The second impact of policy of pension fund is cutting pensions. When pensions will be cut by a maximum of 7 percent and the risk lies for 50% by the sponsor and 50% by the participant, then sponsor support is approximately halved. For example, if we start with an initial funding ratio of 90% there is only 18.0% of 35.9% sponsor support left. Therefore if we cut pensions in the assumed way sponsor support can be much less than without this policy option, such that sponsors need less resources. If the maximum percentage of cutting is changed to 3%. Then sponsor support also decreased, but less as in case of maximum cutting of 7%. We should still be careful about the fact that sponsors do not have the resources. If we increase the maximum percentage of cutting to 15%, then the same holds as in case of cutting of 7% only sponsor support is decreased even more.

The last impact of policy of pension fund is indexation. There is no impact if the initial funding ratio is below 110% for all percentages of indexation. Above 110% results in more sponsor support. It also depends on how much the percentage of indexation is. In case of 2.4% indexation, with an initial funding ratio of 120%, sponsor support will be increased to 13.3% and in case of 10% indexation to 19.9%. Therefore the sponsor needs more resources with this policy option.

Next we investigated the impact of the short rate of the financial market. A decrease in the short rate will have no impact on the sponsor support. Only a big increase of the short rate results in an impact for sponsor support. However a big increase of the short rate doesn't occur in reality. Therefore this give the same results as before inserting this policy.

Lastly, we will conclude this section with two discussions. One discussion is about the initial idea of introducing the holistic balance sheet approach and thereafter we will discuss the IORP II Directive in general. The initial idea of the holistic balance sheet approach is that it is introduced for harmonization of monitoring of pension systems in Europe. In Europe there are different pension funds, pension funds with steering instruments and pension funds without steering instruments. It seems to be logical that a pension fund with steering instruments, such as sponsor support, has less solvency requirements than a pension fund without steering instruments. The fact is, that a pension fund with sponsor support has a higher funding ratio after the additional payment, than a pension without sponsor support. This seems to be a good way to better compare pension funds, but we found that sponsor support can be in some cases a significant amount to actually become at the minimum funding ratio. Furthermore introducing the HBS will raise the costs for pension funds, since the valuation model looks like more complex ALM-models and more assumptions and specific expertise are needed. Larger pension funds can maybe realize these extra costs, but this can be a big problem for smaller pension funds. Moreover the HBS has added value for funded systems and pension systems with guarantees where often steering instruments are present, but less for other pension systems. An example is defined contribution, that requires no additional steering instruments. In that case the HBS looks like a traditional balance sheet. The HBS can lead to pseudo-security, since pension funds can maybe invest more risky than before introducing the HBS. Furthermore in EIOPA's advice on the review of the IORP Directive there are more definitions of sponsor support. The several definitions of sponsor support creates confusion about how to value sponsor support by law. We can conclude from the HBS approach that it offers interesting insights, but in its current form is unsuitable as monitoring tool due to the unclear definition of sponsor support.

In this thesis, we mainly zoomed in on a specific part of the IORP II Directive. When we look to the IORP II Directive in general the Groupe Consultatif thinks the largest improvement with respect to the current situation is providing more transparency to participants of a pension fund regard to the risk the participants face and risk considerations of the pension funds (Actuarieel Genootschap, 2012). This is indeed an improvement when there is a clear definition of sponsor support and we know how to value it. Furthermore the IORP II Directive will increase the security requirement from 97.5% to 99.5%, which is consistent with the Solvency II Directive for insurers. This can result in an increase in the buffer requirements (capital requirement[9]) for Dutch pension funds with approximately 11% of liabilities (Kamp, 2012). This involves the increase from the capital requirement (approximately 25% of liabilities) that according to the Financial Assesment (FTK) in equilibrium for an average fund must be maintained. This calculation was based only on the increase of the security requirement of the current Dutch 97.5% to 99.5%. Other elements of the Directive are not included. In case of an increase of the security requirement, pension funds may be invest less risky and therefore the probability of smaller pensions can be larger.

8.2 Recommendations for further research

During doing the research and writing this thesis we made a lot of assumptions. We could relax this assumptions to make things more realistic. In this section we will explain one by one the most interesting assumptions to be relaxed.

First of all, we assumed a closed pension fund. This is not a realistic assumption. In reality, the number of participants in a pension fund changes over time. The number of participants affects the liabilities of a pension fund. As a result the funding ratio is also affected. For further research we recommend to include mortality rates in the models.

Secondly, in this thesis we define sponsor support as contingent assets of the sponsor. In EIOPA's advice on the review of the IORP Directive there are more definitions of sponsor support. A recommendation for further research could be to value sponsor support under the other definitions and compare them. On the other hand the several definitions of sponsor support creates confusion about how to value sponsor support by law. For further research there should be one clear definition of sponsor support.

[9] In Dutch: Vereist eigen vermogen

Furthermore, in Chapter 4 we made some assumptions of sponsor support. One of the assumptions we made is that a sponsor has unlimited resources to make additional payments to the pension fund. In reality it is not obvious that a sponsor has unlimited resources. For further research we could think of contracts between pension funds and sponsors with an agreed maximum additional payment beforehand.

Moreover we can recommend to look at other countries, since the IORP II Directive will be introduced throughout Europe. In this thesis we only look to Dutch pension funds, however the results can be differ over countries with different policy options. For example in the Netherlands most pension funds guarantee a nominal pension (CPB, 2011), while in other countries pension funds can guarantee a real pension. In case of a real pension a recommendation for further research could be inserting a stochastic process for inflation. A lower inflation level takes care of lower liabilities, which results in higher funding ratios for pension funds. Funding ratios is an important aspect in valuing sponsor support. We could insert the price index model. This price index model consists of a constant yearly price inflation, such that there will be no inflation risk. We could even expand this to take inflation risk into account.

Lastly, we assumed the Black-Scholes and Vasicek model. These are simplified representations of the actual financial market. Black-Scholes consists of only one risky and one risk-less asset. This does not represent the numerous investment opportunities. Furthermore, the Vasicek model is a short-term interest rate model and exhibits mean reversion. However it is more realistic that the long-term interest rate is volatile. A recommendation for further research could be to insert fluctuating long-term rates.

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Appendix A

Tables Sensitivity Analysis

In this appendix the tables of the sensitivity analyses are presented. Every value of sponsor support contains two confidence intervals (CI):

1. 80%-CI
2. 80%-CI conditional on the sponsor making a payment

Initial value funding ratio	Sponsor Support under MoSes ESG (in % of liabilities)	Sponsor Support under Black-Scholes/Vasicek (in % of liabilities)
90%	35.9 [15.0 , 64.6] [15.0 , 64.6]	33.1 [15.0 , 64.4] [15.0 , 64.4]
105%	20.9 [0.0 , 49.6] [4.0 , 52.7]	18.1 [0.0 , 47.1] [2.5 , 55.4]
120%	11.4 [0.0 , 35.2] [2.6 , 47.0]	8.2 [0.0 , 27.0] [2.2 , 65.2]

Table A.1: Results of the sensitivity analysis on the initial funding ratio

Initial value funding ratio	Sponsor Support (in % of liabilities)	Sponsor Support with asset mix 10-90 (in % of liabilities)	Sponsor Support with asset mix 60-40 (in % of liabilities)	Sponsor Support with asset mix 90-10 (in % of liabilities)
90%	**35.9** **[15.0 , 64.6]** **[15.0 , 64.6]**	32.9 [15.0 , 54.5] [15.0 , 54.5]	38.7 [15.0 , 71.7] [15.0 , 71.7]	43.5 [15.0 , 85.0] [15.0 , 85.0]
105%	**20.9** **[0.0 , 49.6]** **[4.0 , 52.7]**	17.9 [0.0 , 39.5] [2.7 , 40.7]	23.7 [0.0 , 56.7] [4.9 , 61.1]	28.5 [0.0 , 70.0] [6.9 , 75.3]
120%	**11.4** **[0.0 , 35.2]** **[2.6 , 47.0]**	8.0 [0.0 , 24.5] [2.0 , 38.7]	14.5 [0.0 , 42.9] [3.0 , 54.0]	19.7 [0.0 , 57.1] [5.4 , 68.4]

Table A.2: Results of the sensitivity analysis with different asset mixes

Initial value funding ratio	Sponsor Support (in % of liabilities)	Sponsor Support with max 7% cutting (in % of liabilities)	Sponsor Support with max 3% cutting (in % of liabilities)	Sponsor Support with max 15% cutting (in % of liabilities)
90%	**35.9** **[15.0 , 64.6]** **[15.0 , 64.6]**	18.0 [7.7 , 32.1] [7.7 , 32.1]	26.5 [11.9 , 46.9] [11.9 , 46.9]	15.5 [6.9 , 26.8] [6.9 , 26.8]
105%	**20.9** **[0.0 , 49.6]** **[4.0 , 52.7]**	11.1 [0.0 , 26.3] [2.0 , 28.4]	15.1 [0.0 , 36.1] [2.0 , 39.4]	9.3 [0.0 , 21.5] [2.0 , 22.8]
120%	**11.4** **[0.0 , 35.2]** **[2.6 , 47.0]**	6.1 [0.0 , 18.8] [1.3 , 25.5]	8.2 [0.0 , 25.5] [1.3 , 34.6]	5.1 [0.0 , 15.7] [1.3 , 20.6]

Table A.3: Results of the sensitivity analysis with different maximum values of cutting pensions

Initial value funding ratio	Sponsor Support (in % of liabilities)	Sponsor Support with 2.4% indexation (in % of liabilities)	Sponsor Support with 10% indexation (in % of liabilities)
90%	**35.9** **[15.0 , 64.6]** **[15.0 , 64.6]**	36.5 [15.0 , 65.2] [15.0 , 65.2]	38.3 [15.0 , 66.1] [15.0 , 66.1]
105%	**20.9** **[0.0 , 49.6]** **[4.0 , 52.7]**	21.5 [0.0 , 50.2] [4.2 , 52.8]	23.3 [0.0 , 51.1] [4.6 , 53.5]
120%	**11.4** **[0.0 , 35.2]** **[2.6 , 47.0]**	13.3 [0.0 , 38.7] [2.8 , 47.9]	19.9 [0.0 , 48.8] [4.9 , 53.5]

Table A.4: Results of sensitivity analysis with different percentages of indexation

Initial value funding ratio	Sponsor Support (in % of liabilities)	Sponsor Support with short rate 0,5% (in % of liabilities)	Sponsor Support with short rate 5% (in % of liabilities)
90%	**33.1** **[15.0 , 64.4]** **[15.0 , 64.4]**	32.4 [15.0 , 62.2] [15.0 , 62.2]	36.1 [15.0 , 68.9] [15.0 , 68.9]
105%	**18.1** **[0.0 , 47.1]** **[2.5 , 55.4]**	16.6 [0.0 , 45.8] [2.4 , 55.7]	21.4 [0.0 , 54.3] [2.9 , 61.2]
120%	**8.2** **[0.0 , 27.0]** **[2.2 , 65.2]**	7.7 [0.0 , 25.9] [2.2 , 65.4]	10.2 [0.0 , 34.4] [2.3 , 64.9]

Table A.5: Results of sensitivity analysis with different short rates