



Network for Studies on Pensions, Aging and Retirement

# Netspar DESIGN PAPERS

*Erwin Fransen, Niels Kortleve, Hans Schumacher,  
Hans Staring and Jan-Willem Wijckmans*

## The holistic balance sheet as a building block in pension fund supervision



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# The holistic balance sheet as a building block in pension fund supervision

DESIGN PAPER 18



Network for Studies on Pensions, Aging and Retirement

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# CONTENTS

<i>Preface</i>	7
<i>1. Introduction</i>	11
<i>2. Holistic Balance Sheet</i>	13
<i>3. Modeling of the Holistic Balance Sheet</i>	25
<i>4. Capital requirements</i>	34
<i>5. Supervision based on the Holistic Balance Sheet</i>	39
<i>6. Conclusions</i>	46
<i>Appendix A: Summary of all propositions made in this paper</i>	48
<i>Appendix B: Correlation matrices used to calculate the final net and gross SCR</i>	50
<i>Literature</i>	51



## PREFACE

Netspar seeks to stimulate debate on the effects of aging on the behavior of men and women, (such as what and how they save), on the sustainability of their pensions, and on government policy. The baby boom generation is approaching retirement age, so the number of people aged 65 and over will grow fast in the coming decades. People generally lead healthier lives and grow older, families have fewer children. Aging is often viewed in a bad light since the number of people over 65 years old may well double compared to the population between 20 and 65. Will the working population still be able to earn what is needed to accommodate a growing number of retirees? Must people make more hours during their working career and retire at a later age? Or should pensions be cut or premiums increased in order to keep retirement benefits affordable? Should people be encouraged to take personal initiative to ensure an adequate pension? And what is the role of employers' and workers' organizations in arranging a collective pension? Are people able to and prepared to personally invest for their retirement money, or do they rather leave that to pension funds? Who do pension fund assets actually belong to? And how can a level playing field for pension funds and insurers be defined? How can the solidarity principle and individual wishes be reconciled? But most of all, how can the benefits of longer and healthier lives be used to ensure a happier and affluent society? For many reasons there is need for a debate on the consequences of aging. We do not always know the exact consequences of aging. And the consequences that are nonetheless clear deserve

to be made known to a larger public. More important of course is that many of the choices that must be made have a political dimension, and that calls for a serious debate. After all, in the public spectrum these are very relevant and topical subjects that young and old people are literally confronted with.

For these reasons Netspar has initiated Design Papers. What a Netspar Design Paper does is to analyze an element or aspect of a pension product or pension system. That may include investment policy, the shaping of the payment process, dealing with the uncertainties of life expectancy, use of the personal home for one's retirement provision, communication with pension scheme members, the options menu for members, governance models, supervision models, the balance between capital funding and pay-as-you-go, a flexible job market for older workers, and the pension needs of a heterogeneous population. A Netspar Design Paper analyzes the purpose of a product or an aspect of the pension system, and it investigates possibilities of improving the way they function. Netspar Design Papers focus in particular on specialists in the sector who are responsible for the design of the component.

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# THE HOLISTIC BALANCE SHEET AS A BUILDING BLOCK IN PENSION FUND SUPERVISION

## 1. Introduction

In its advice on the review of the IORP Directive, EIOPA proposed the holistic balance sheet (HBS) as a new and innovative way to assess pension funds in a harmonized manner (EIOPA 2011). Not only traditional financial assets and liabilities, but all steering mechanisms available to the pension fund should be taken into account. EIOPA considers using the HBS as a supervisory tool for all European pension funds that involve risk sharing and guarantees. The HBS and the valuation of steering mechanisms are new concepts and so far only in the very early stages of development. It is therefore necessary to analyze whether the intended use is feasible and what challenges lie ahead. In this paper, we make a first assessment of the possibilities of using the HBS in pension fund supervision.

In Chapter 2, we present a general introduction of the HBS concept. We do so by explaining the structure and by comparing it to the traditional balance sheet of a fictitious but realistic pension fund. We also show how the steering mechanisms react to different external changes in both economic and policy structure. In Chapter 3, we discuss several calibration issues that arise and show how the uncertainties and necessary choices may affect the outcome of the analyses. In Chapters 4 and 5, we start looking at the possibilities of using the HBS as a supervisory tool. In Chapter

4, we compare the required capital for the same case used earlier in Chapter 2. Finally, in Chapter 5, we explicitly focus on the purpose of supervision and draw conclusions from the analyses in earlier chapters.

## 2. Holistic Balance Sheet

### 2.1 General structure of the HBS

The HBS is in essence similar to a traditional balance sheet as it shows all assets and liabilities in a single overview. However, the value of additional steering mechanisms is also taken into account. The following steering mechanisms are usually mentioned (CEIOPS 2008):

- Sponsor support
- Conditional contribution increases
- Conditional indexation
- Partial or limited indexation
- Ex-ante or ex-post benefit reduction
- Pension protection schemes

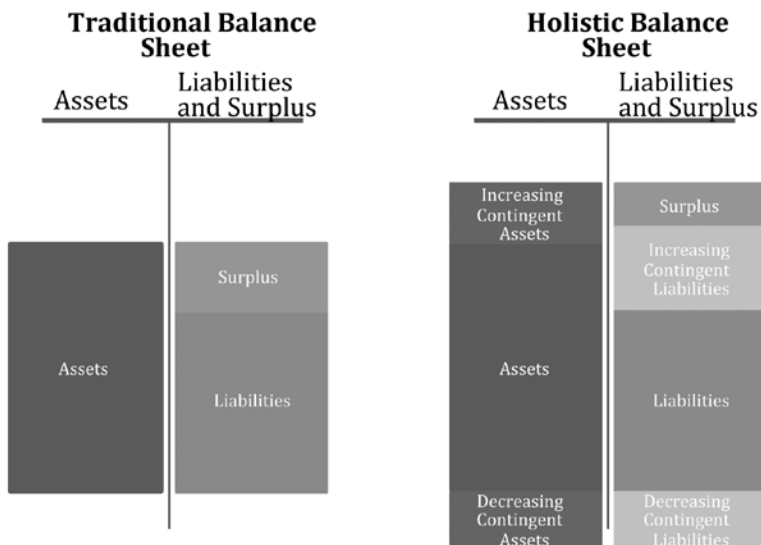


Figure 1. The traditional versus the holistic balance sheet

For most steering mechanisms, the conditional payoff depends on some underlying decision variable. The inclusion of steering mechanisms leads to an extended balance sheet compared to a traditional balance sheet. In Figure 1, the general structure of an HBS is shown next to the traditional structure.

Depending on the specific policies of a pension fund, the balance sheet may be expanded on the asset side or on the liability side. The contingent elements will cause the value of the surplus to change.

The HBS gives a more complete view of the financial situation of a pension fund. After all, the benefits of a pension fund that is backed by a sponsor guarantee will in general be better secured than an otherwise identical fund without such backing. This is reflected in the HBS, but not in the traditional balance sheet.

## **2.2 Structuring an HBS for a pension contract**

The value of the contingent assets and liabilities depends heavily on the evaluation horizon: the longer the evaluation horizon, the greater the value of a particular steering mechanism. After all, the value of 15 years of recovery contributions will always be more than the value of 5 years of such contributions. We have chosen here to apply an evaluation horizon that is broadly equal to the average duration of pension liabilities, in our case 15 years. In Figure 3 we have graphed what the HBS, based on the described policy in the box, would look like compared to the traditional representation.

The sponsor support has a market-consistent value for the pension fund of 13. In Chapter 3 we elaborate on the valuation method of the steering mechanisms. For now, suffice it to say that this value represents the average risk-weighted value of the total sponsor payments in each scenario during the 15-year

period considered. Some scenarios (positive and otherwise) will show that they receive no sponsor support at all, while in other scenarios the additional contribution will be received in most or all years. The value can be interpreted as the price the pension fund should receive if sponsor support were to be removed as

**Box: a typical Dutch pension fund**

- The pension contract is a defined benefit (DB) contract.
- All policy decisions are based on a funding ratio that is determined by traditional assets and liabilities that reflect market valuation. The contingent elements of the HBS are not included.
- Indexation depends on the market funding ratio (see Figure 2). Full wage indexation is given above a funding ratio of 120%, and indexation is withheld below 105%. Between 105% and 120% the indexation is linear.
- At a funding ratio below 120%, a 2% recovery contribution is paid in. Below 105%, an additional 5% is added on top.
- When the funding ratio exceeds 100% real (i.e. including all future unconditional indexation), there is a 5% discount on the base contribution. Any indexation gap is compensated.
- We do not take into account new accruals and corresponding contributions.
- The asset mix consists of 40% equities and 60% bonds. The interest rate risk of liabilities stated at market value is hedged for 50%.
- The initial funding ratio is 105%.

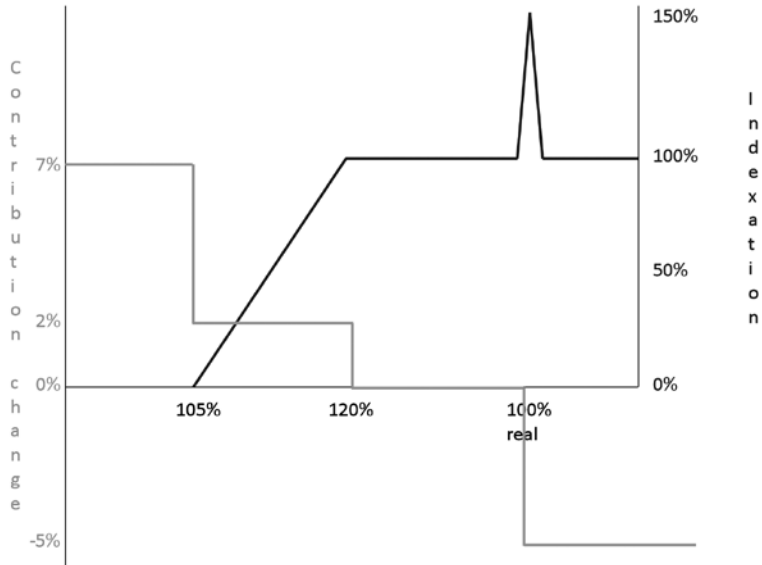


Figure 2. Illustration of contribution and indexation policies

a policy. From the cash received, the pension fund should be able to purchase the exact same option in the financial market, making current and future participants indifferent to the change. The higher assets are only part of the story, however. On the liability side, we note that the conditional indexation increases liabilities by 12. From the initial position of the market funding ratio of 105%, partial indexation starts even if the funding ratio increases only slightly. Even though no indexation is granted at inception, the likelihood of future indexation still leads to a value larger than 0. To put the value into perspective: that of unconditional indexation would be 38.

All options considered, the HBS shows a surplus of 6 at inception, whereas in a regular balance sheet the surplus is 5.



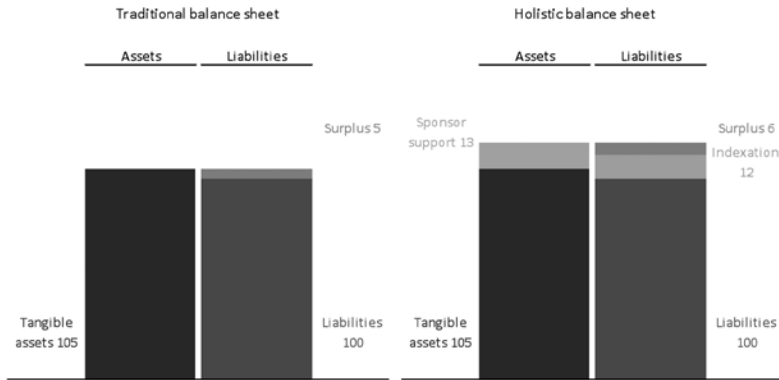


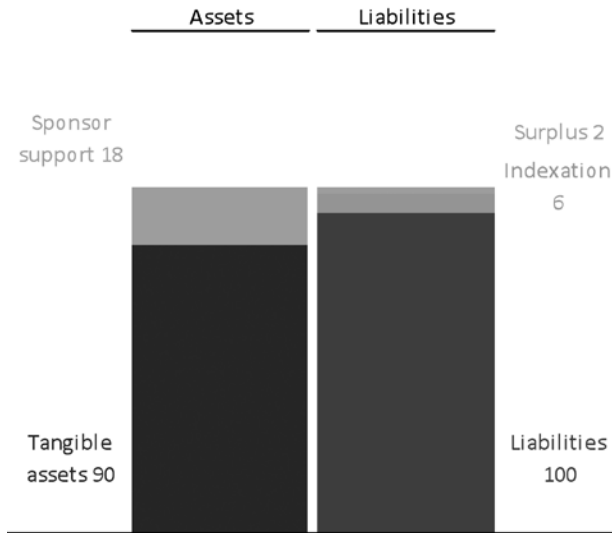
Figure 3. The traditional versus the holistic balance sheet

The impact on surplus of changing to an HBS will differ per fund and per situation: in this case the increase by 1 does not seem much. In the later analyses in Section 2.3, we will show how this can change with different assumptions. Later on, in Chapter 4, we will see that the impact does not end there, but that the capital requirements are also impacted.

### 2.3 Valuations in HBS depend on financial situation, pension contract, and volatility

The steering mechanisms on the HBS can be thought of as financial options, their pay-off depending on the underlying market funding ratio. As the underlying value (the funding ratio) changes, so will the value of the options. In this section, we will first show the effect of a lower starting funding ratio. We will also perform several sensitivity analyses.

Figure 4 shows the HBS with a starting market funding ratio of 90% rather than 105%. With a lower funding ratio we would expect the contributions and their market-consistent value to increase. Furthermore, the probability and magnitude of



*Figure 4. The effect of a lower starting funding ratio*

indexation should be lower, as greater recovery is necessary before indexation can be resumed.

We indeed see in Figure 4 that the option values react as predicted. The reduction in tangible assets by 15 is partly compensated by an increase of 5 in sponsor support value plus a decrease of 6 in indexation value. This leads to a much smaller reduction of the HBS surplus than in a traditional balance sheet. The steering mechanisms act like assets with a strong negative correlation to the tangible assets, effectively reducing the impact of shocks on the balance sheet.

Assuming a lower market funding ratio at inception is only one of the many sensitivity analyses that can be performed. In Table 1, we show the effect of a riskier investment mix and the effect of contribution and sponsor support on the one hand and

	no contribution and sponsor support					
	Traditional	HBS base case	more equity	support	no indexation	5 year evaluation
Assets	105	105	105	105	105	105
Contribution and sponsor support		13	14	0	12	3
Total assets	105	118	119	105	117	108
Liabilities	100	100	100	100	100	100
Indexation		12	12	9	0	3
Total liabilities	100	112	112	109	100	103
Equity	5	6	7	-4	17	5
Funding ratio	105%	105%	106%	96%	117%	105%

*Table 1. Summary of results of sensitivity analyses*

indexation on the other hand. Lastly, we show the impact of an evaluation horizon of five instead of fifteen years<sup>1</sup>.

The steering mechanisms can be viewed as financial options. We know from standard option theory that the value of such an option increases with the volatility of the underlying asset. This is the precise effect of choosing a riskier asset mix. Instead of 40% investments in equities, we now invest 60% in equities. However, the effect is not very substantial because of the specific characteristics of the options, explained as follows. The indexation option is not an option that will pay out more with every rise of the funding ratio. Instead, once a certain threshold is breached, the indexation is capped. As a riskier investment mix will mostly lead to good scenarios becoming better, the indexation paid will not improve substantially. The value of contribution and sponsor support increases somewhat more. The net effect of 20% more investment in equities is only a small increase in surplus. This means that, while a pension fund could theoretically choose to improve on its HBS funding ratio by taking more investment risk, the effect does not seem to be very large. Moreover, the net effect of the improvement in funding ratio and the increase of the

1 Also see De Haan et al. (2012) on the impact of taking a different approach on the horizon and looking at the pension fund from an open or closed position.

net SCR will have to be taken into account simultaneously (see Chapter 4).

The biggest impact is in those variants where we remove one of the steering mechanisms altogether. In the case of 'no contribution and sponsor support' we note that we only have steering mechanisms that increase the value of the liabilities, thus reducing the surplus. Interestingly, we see that the value of the indexation is lower than it is in the base case (9 versus 12): the loss of the additional contribution steering mechanism also impacts the indexation granted. The conditional indexation partially absorbs the lower value of the contingent assets and mitigates the impact on the deficit/surplus.

We observe the same relation when looking at the case of 'no indexation'. In this case, we only have additional steering mechanisms that increase the assets, so the HBS surplus increases. The fact that no indexation is granted also lowers the need for additional funds: the sponsor and contribution option decreases slightly in value (from 13 to 12).

These results demonstrate well how the different steering mechanisms interact and that changing one policy instrument impacts the value of the others. No conclusions can be drawn about the overall picture of the fund by looking only at individual steering instruments.

*Proposition 1: The different elements of the HBS have to be assessed jointly to account for mutual dependencies.*

Decreasing the valuation horizon leads to a lower value of both steering mechanisms, indicating that a large part of the option values is concentrated after the first five years. Note that this valuation issue is not so much that we are valuing an option with

a shorter maturity, as well as removing some options out of the equation altogether. Indeed, the indexation and contribution policies can be seen as a string of 1-year options, with each option dependent on the payoff of all previous options. A decrease in the valuation horizon to five years therefore effectively removes two-thirds of the options and their respective values. In the example where we consider both contingent assets and liabilities, both steering instruments react more or less in the same magnitude, effectively leading to a minor impact on surplus. One can easily see, however, that for a fund that would have recourse to only one of the two, the choice of horizon would become very dominant in determining the overall solvency position. This shows that the choice of horizon is very important should the HBS be used in prudential supervision.

*Proposition 2: The value of the steering mechanisms depends heavily on the evaluation horizon. In setting prudential supervision rules, one should be very careful when deciding on this horizon.*

#### **2.4 Benefit reduction**

One of the most important steering mechanisms that are available to a pension fund, that clearly distinguishes this from an insurer, is the possibility to cut benefits in case of underfunding. We distinguish two forms. The first is the situation where benefit reduction has been agreed upon as a regular steering mechanism (e.g. in individual DC plans), referred to as an ex-ante benefit reduction mechanism. The second is an ex-post benefit steering mechanism; this is not a regular instrument but a measure of last resort in case all other options are worn out. Not all pension funds have the possibility to use either one of these steering

mechanisms. In the UK for example, pension funds are by law forbidden to lower the rights of participants, whether ex-post nor ex-ante. As a measure of last resort, benefit reduction is allowed under current Dutch law. Moreover, the new Pension Agreement that has been established in the Netherlands allows for explicit ex-ante benefit steering. The separation into ex-post and ex-ante benefit reduction is also used in the technical specifications released by the European Commission (EC 2012).

#### *2.4.1 Ex-post benefit reduction*

Benefit reduction as a measure of last resort is not a regular steering mechanism. In a collective system without an extremely strong guarantor, it is pragmatically acknowledged that even a benefit that is secured at a certain level (even 99.5% or higher) is still not 100% secure. The ex-post benefit reduction mechanism as such is therefore not part of the security level of the fund but the remainder after the security level has been breached. If a prudential supervision regime chooses to focus on the security of participants, it makes sense to either keep the value of ex-post benefit reduction off balance or to apply a clear tiering of assets, in which the value of ex-post benefit reduction has a reduced contribution toward the security level.

*Proposition 3: Ex-post benefit reduction is best kept off balance or recognized as a balancing item with lower tiering towards a desired security level.*

#### *2.4.2 Ex-ante benefit reduction*

Contrary to ex-post benefit reductions, ex-ante benefit reductions can be included as a steering instrument when well communicated and understood by members. Clearly, the possibility to

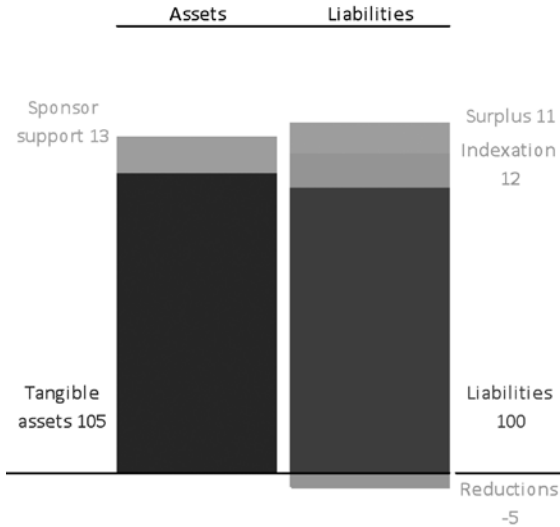


Figure 5. Inclusion of ex-ante benefit steering

reduce benefits does not raise the level of security of current pension benefits, but it does raise the level of security of the pension fund. The question is whether prudential regulation aims to ‘protect’ the benefits of participants or of the pension fund itself. It is worth noting that a collective pension system with ex-ante benefit reduction is a synthesis of DB and DC (see Boeijen et al. 2012 and Kortleve 2013 for more on Defined Ambition). Figure 5 shows the impact of ex-ante benefit steering in addition to the contribution and indexation policy from Figure 2, with benefit cuts being applied if recovery to a funding level of 105% has not been realized within three years.

By comparing Figure 5 with Figure 3 one can see that the addition of benefit reduction does not greatly impact the value of the two other steering mechanisms. Mostly, in those scenarios

where benefit reduction is applied, the reduction does not greatly improve the odds that over the remainder of the horizon the additional sponsor support will no longer be necessary or that indexation can be resumed more quickly. Of course, if benefit cutting would be more severe or quicker than assumed in this example, the impact on the value of the other steering mechanisms will become more pronounced. The result of the minimal impact of the other steering mechanisms in this case is that surplus increases by the full amount of the negative change in value of the contingent liabilities. Ex-ante benefit reduction is a natural instrument if there is no guarantor of last resort to honor promises. Inclusion of this as a regular steering instrument can provide transparency to participants on the certainty (or lack thereof) of their pension benefit.

*Proposition 4: Ex-ante benefit steering is an important element in making the pension contract complete, especially if there is no guarantor of last resort to honor promises.*



### 3. Modeling of the Holistic Balance Sheet

According to the technical specifications of the European Commission (EC 2012) the best estimate of technical provisions should be valued on a market-consistent basis by applying quoted market prices. If liabilities cannot be perfectly replicated by financial instruments that are quoted in deep, liquid, and transparent financial markets, adjustments to the market price must be made to reflect the differences. If market prices are not available or adjustments to these prices too complex, IORPs can use alternative valuation methods that are arbitrage-free and rely as little as possible on IORP-specific inputs. This implies that risk-neutral models, deflators, or other market-consistent models must be used. For ease of discussion this chapter will be phrased in terms of risk-neutral models, even though deflators<sup>2</sup> could also be used. In the sections below we will discuss the impact of the specific choice of market information that is used to calibrate this model.

#### 3.1 Risk-neutral valuation

Risk-neutral models generate scenarios that do not incorporate risk premiums. This allows the risk-free interest rate curves within the set to be used for discounting all cash flows. This is a major advantage over models that use risk premiums within the scenarios, where the determination of the appropriate discounting factors is less straightforward. The risk-neutral scenario sets are constructed such that the market-consistent value equals the discounted value of payoffs. The market's sensitivity to risk is taken into account in the scenario generator.

2 See also Hibbert et al. (2006) on the techniques for market-consistent valuation of contingent claims.

In this respect the calibration of the risk-neutral model to market prices is very important. If a risk-neutral valuation model is calibrated correctly, the valuation of a market instrument should equal its current market price.

### **3.2 Choosing a risk-neutral model**

There is a wide range of risk-neutral valuation models. Banks often use tailored models to price a specific derivative. As an example, the models that banks use to price interest rate caps differ from the models for pricing swaptions, whereas both derivatives are subject to the same interest rate risk. Tailored models make calibration easier and are therefore believed to make pricing more accurate. When the payoffs of a claim depend on several economic variables such as interest rates, inflation, and equity returns, these variables need to be incorporated. That leads to more broadly defined models; see for instance Overhaus et al. (2007) and Van Haastrecht et al. (2009). In this case more model risk is present when valuation is done for products that are dissimilar to the ones that have been used for calibration.

Defined Benefit schemes embed complicated contingent claims. These claims can depend on investment returns, the term structure of interest rates, and inflation, as conditional indexation and other measures are triggered by the funding ratio. An economic scenario generator therefore has to include at least a model for equity returns and inflation and a model for the evolution of the term structure. The Black-Scholes model is a commonly accepted (although not the only) framework for equity returns, but there is less agreement concerning term structure models. In the academic literature, linear term structure models are favourite due to their tractability. The model proposed by Koijen et al. (2010) may be taken as an example. The variables

of this model are driven by a four-dimensional Brownian motion. The price of risk is specified explicitly and is allowed to depend linearly on the two state variables associated to the term structure. Among alternative model structures, one may mention models that include state jumps (as in Van den Goorbergh et al. 2011) and models that incorporate regime shifts (e.g. Ang et al. 2008). Also variations of the Hull-White interest rate model, such as the one-and-two factor, are generally accepted risk-neutral term structure models.

### **3.3 Calibrating risk-neutral models**

Market-consistent valuation of derivatives does not require additional assumptions when the derivatives at stake are actively traded. However, to price derivatives for which no liquid market exists, this is not the case. When products are related to liquidly traded products, simple models can suffice. As an example, swaptions that differ from regularly traded swaptions only by a nonstandard option maturity date can be adequately priced by means of the Black (1976) model.

Given the complexity of pension products in the Netherlands, it is necessary to value them using more broadly defined models. Substantial model risk in the calibration process is unavoidable for these models. It may be noted, however, that, in the HBS context, prices are not calculated for trading purposes, and therefore lower accuracy could be acceptable.

For the calibration of equity returns and interest rates, market information can be used although the question remains exactly which specific market information to use. At any given valuation date more market prices of different derivatives can be obtained than can possibly be used in the model, thus requiring a subjective selection. For price and wage inflation and long

term volatilities no relevant market information can be found for calibration purposes (see Broeders et al. 2012 for an overview of valuation issues).

*Proposition 5: The hybrid nature of contingent claims embedded in pension contracts calls for the development of extensive models.*

### 3.4 Sensitivity analysis

In this section we illustrate the choice of specific market information that is used for calibrating a risk-neutral model. For this purpose we choose a combination of models, namely a Hull-White model for term structures of interest rates and Black-Scholes models for equity returns and price inflation.

When calibrating the Hull-White model based on market information, the derived parameters are subject to model risk. Apart from that, only a subset of the available market information is used for calibration. Another subset could easily be chosen,

#### **Box: a calibrated model**

The term structure and equity models are calibrated based on market information of December 30, 2011. As there is no deep and liquid market for the price inflation and correlations between the various economic variables, assumptions are derived from a historic dataset (1977-2010). This leads to the following assumptions for the main parameters:

- $\alpha$  (first mean reversion parameters Hull-White) = 47.7%
- $\beta$  (second mean reversion parameters Hull-White) = 6.95%
- $\sigma_1$  (first volatility parameter Hull-White) = 0.39%
- $\sigma_2$  (second volatility parameter Hull-White) = 0.59%

- $\rho_{r,u}$  (correlation between short rate and short-term mean reversion level  $u$ ) = 0.95
- $\sigma_S$  (volatility of equity returns) = 20%
- $\rho_{r,S}$  (correlation between equity and short rate) = 0%
- $\sigma_P$  (volatility of price index) = 0.8%
- $\rho_{r,p}$  (correlation between short rate and price index) = 0.8%
- $\mu_P$  (expected price inflation) = 2%

We refer to this model as the base case.

The model specification under the risk-neutral measure is as follows:

$$dS(t) = r(t) \cdot S(t) \cdot dt + \sigma_S \cdot S(t) dWS(t)$$

$$dr(t) = (\theta(t) + u(t) - \alpha \cdot r(t)) \cdot dt + \sigma_1 \cdot dWr(t)$$

$$du(t) = -\beta \cdot u(t) + \sigma_2 \cdot dWu(t)$$

$$dP(t) = \mu_P \cdot P(t) \cdot dt + \sigma_P \cdot P(t) \cdot dWP(t)$$

$$dWS(t) = \rho_{r,S} \cdot dWr(t) + \sqrt{1 - \rho_{r,S}^2} \cdot dWS'(t)$$

$$dWu(t) = \rho_{r,u} \cdot dWr(t) + \sqrt{1 - \rho_{r,u}^2} \cdot dWu'(t)$$

$$dWP(t) = \rho_{r,p} \cdot dWr(t) + \sqrt{1 - \rho_{r,p}^2} \cdot dWP'(t)$$

where  $Wr(t)$ ,  $WS'(t)$ ,  $Wu'(t)$ , and  $WP'(t)$  are independent Brownian motions, and the deterministic function of time  $\theta(t)$  is chosen such that the initial term structure matches the market data. The variable  $u(t)$  is interpreted here as representing a medium-term deviation of the mean reversion level of the short rate; given the simple geometric Brownian motion model adopted above for inflation,  $u(t)$  cannot be viewed as representing inflation expectations.

which may lead to other Hull–White parameters. Model risk also comes from the choice of the data period used for estimates of correlations and expected inflation. Results of a preliminary sensitivity analysis with respect to model risk are shown in Figure 6.

The parameters used in the sensitivity analysis are:

- $\alpha = 70\%$  (increase of the mean reversion of interest rates)
- $\mu_p = 3\%$  (increase of the expected inflation rate)
- $\rho_{r,S} = 20\%$  (increase of the correlation between equity and short interest rate)
- $\rho_{r,S} = -20\%$  (decrease of the correlation between equity and short interest rate)

The choice of another data period (such as including the 1970s) could easily lead to an inflation rate assumption in the Black–Scholes inflation model increasing by 1 percentage point. For pension funds with (conditional) indexation the impact of the assumption for the expected price inflation is substantial. In our example the value of the conditional indexation in the HBS increases with more than 70%, when the assumption for expected price inflation is raised by 1%. The value of the sponsor support increases by more than 20%. Compared to a situation in which the funding ratio is higher (125% instead of 105% in the base case of Chapter 2), these increases remain substantial.

As the first mean reversion parameter is raised from 48% to 70%, the value of the indexation increases by more than 35%, the exact percentage depending on the funding ratio at inception. When the interest rates revert to a long-term expected level at a quicker pace, these rates are less volatile and on average lower. This is the main reason why the value of sponsor support and conditional indexation increases, as these are discounted at a lower rate.

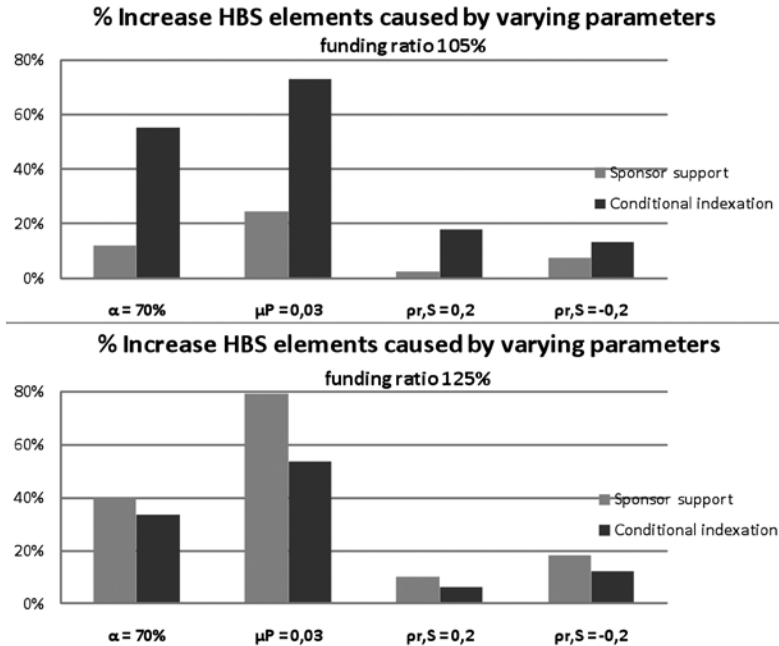


Figure 6. Sensitivity analysis for varying risk neutral model parameters

The impact of a correlation between equity returns and short rates unequal to zero is not as large as for the mean reversion parameter with the Hull-White model and the expected inflation. Surprisingly, we see from Figure 6 that the value of these conditional elements of the HBS increases for both an increase as well as a decrease of the correlation between equity and short rates. When this correlation is positive, combinations of high equity returns and high interest rates occur more frequently in the scenarios. These combinations often lead to full indexation and a higher average indexation, so the higher value of the indexation option seems logical.

With lower and especially negative correlation, these combinations occur less frequently, which leads to a lower average indexation. Still, the value of the indexation option is not lower, because in most situations where indexation takes place, the average discount rate is also lower. The lower average indexations are more than offset by the lower discount rate, effectively increasing the value of the indexation. This illustrates that a change in the value of its conditional elements cannot always be explained in a straightforward manner. A deeper analysis of the outcomes may be required. This makes communication about the HBS (and changes therein) and supervision on basis of the HBS more complicated.

Summarizing, we can state that setting up a valuation model in order to create an HBS for a pension fund, the following choices have to be made:

- Choice of equity, inflation, and interest rate model. Depending on the complexity, additional models on alternative asset classes may be warranted.
- Choice of market information. Decisions have to be made as to which pricing information comes from a liquid and trustworthy source, and which information does not.
- Choice of calibration. Often it is not possible to calibrate the model to price back each and every liquid instrument. A choice can be made to disregard some instruments, or to apply a best fit through all the available data.
- Mark to model where no information is available. The choice on how to extrapolate or otherwise determine non-existing yet important information can have a strong impact on the outcomes.



The sensitivity analysis showed that the outcomes of the HBS can vary substantially depending on the choices regarding these factors.

*Proposition 6: The construction of a valuation model for an HBS involves many different choices. All choices combined can lead to a wide valuation range for balance sheet items. More research has to be undertaken on this subject before an HBS can be used in prudential supervision.*

## **4. Capital requirements**

An important aspect to be examined by the pension fund supervisors is the capital requirements that a fund must adhere to in order to meet the promised level of security. In this chapter, we will show how the steering mechanisms included in the HBS impact the Solvency Capital Requirements (SCR) by taking into account their loss-absorbing capacity.

The SCR is the amount of capital that a pension fund needs in order to limit the risk of insolvency. This risk is the correlated sum of individual risks that a pension fund faces, especially with respect to market risks and risks related to the pension benefit. The SCR can be calibrated to reflect a certain level of security: the higher the security provided to the beneficiaries, the higher the required capital. Under Solvency II, the level of security is 99.5%. The Dutch risk-based solvency requirements, however, are calibrated to 97.5%.

In the remainder of this chapter, we will make a distinction between the gross SCR, which reflects the required SCR without taking into account steering mechanisms, and the net SCR, which does take them into account. This is in line with the draft technical specifications of the European Commission (EC 2012).

### **4.1 SCR for HBS base case**

We will now examine the difference in SCR between the traditional balance sheet and the HBS. Both are based on a 99.5% security level to facilitate comparison and to allow conclusions to be drawn regarding the impact of steering mechanisms on the value of the SCR. The risks in the pension fund described in Section 2.2 are equity risk, interest rate risk, and longevity risk. Table 2 shows the three different steps that are needed in order

	HBS base case	HBS after equity shock	HBS after interest rate shock	HBS after longevity shock	Resulting SCR
Assets	105	92	116	105	
Contribution and sponsor support	13	16	18	14	
Total assets	118	108	134	119	
Liabilities	100	100	121	104	
Indexation	12	7	9	10	
Total liabilities	112	107	130	114	
change in surplus without steering		-13	-10	-4	21
change in surplus including steering		-5	-2	-1	7

*Table 2. Calculation of SCR: stressed balance sheets per risk*

to calculate a gross and net SCR for this relatively simple fund. Each individual shock leads to a change in value of the assets or liabilities, and therefore a change in the HBS. The changes in surplus, both including and excluding the steering instruments, are used to calculate the final net and gross SCR, by using the correlation matrices that are shown in Appendix B. The numbers in the HBS base case come from Figure 3. The numbers in the case 'HBS after equity shock' show the resulting balance sheet entries after an equity shock of 30%. Given an equity allocation of 40%, this results in total assets decreasing by 13 and a resulting traditional funding ratio of 92%. At this level, the total value of indexation falls to 7, reflecting the fact that, at such a low funding ratio, indexation granting is less likely. On the other hand, the value of contribution and sponsor support increases. Note that the results are similar to the sensitivity analysis at a lower funding ratio in Section 2.3. The equity shock results in a change in surplus of -13 if one disregards the change in value of the steering mechanisms. This is the value that feeds directly into the calculation of the gross SCR, as the equity component of market risk. Taking into account the steering mechanisms however, the change in surplus is merely -5.

Table 2 shows the outcomes for the other risks that the fund is exposed to. The changes in surplus for each individual risk factor are added up using the appropriate correlations (see Appendix B). From the changes without steering, we can calculate the gross SCR; the changes including steering lead to the net SCR.

We see that the gross SCR goes down from 21 to 7. The presence of the steering mechanisms in this example is so strong that they replace nearly 75% of the security provided by capital buffers.

#### **4.2 SCR depends on financial situation and pension contract**

Under a risk-based solvency framework without steering instruments, we know that the SCR increases in line with the risk in the investment mix. Under the HBS, this relationship is not that straightforward. Since the SCR now is only the capital component of the security buffer, the SCR not only depends on the investment mix but also on the steering instruments in the pension contract.

Table 3 shows the impact of several changes to the base case, both in terms of the SCR and in terms of free capital, defined as the difference between the surplus and the SCR. This free capital is especially relevant since most prudential supervision frameworks regard it as one of the most important factors for purposes of determining regulatory actions.

To start with the base case, we see that the free capital is significantly improved. We see that this is not the result of the value of the steering mechanisms by itself, as the surplus only changes by 1. Rather, it is the effect of the loss absorbing capacity of the steering mechanisms. This puts great demands on the likelihood of the policies involved. A pension fund that would benefit for years from lower SCR because it relies heavily on sponsor support should make absolutely sure that the expected support will actually be paid when necessary. The same holds

	no contribution and sponsor support							including benefit steering
	Traditional	HBS base case	more equity	no indexation	5 year projection			
Total assets	105	118	119	105	117	108	118	
Total liabilities	100	112	112	109	100	103	107	
Surplus	5	6	7	-4	17	5	11	
SCR	21	7	11	15	14	15	6	
Free capital	-16	-1	-4	-19	3	-10	5	

*Table 3. Overview of SCR under different investment mixes and pension contracts*

true for the supervisory authority that is in charge of assessing the policies. Any misrepresentation of the expected policies can lead to serious understatement of the actual risks that fund participants face.

*Proposition 7: The SCR calculation relies heavily on the accuracy and realism of the formulated policies. Inclusion of the loss absorbing capacity of steering mechanisms imposes high demands on the assessment of the policies.*

As we have already noted in Section 2.3, shifting to a more risky asset mix only marginally improves the surplus in the HBS. By taking into account the capital requirements, we see that the overall effect is indeed negative: the free capital decreases, thus requiring more measures to be taken. In terms of governance this is good news: a supervisory regime should not lead to a built-in incentive to increase risk.

Looking at the last four sensitivity analyses, we can see that some of the cases actually have a positive free surplus, whereas the traditional starting point initially showed a substantial negative free surplus. This should, however, not be interpreted as a 'free lunch' for the pension fund, where it only needs

to define some policy rules in order to avoid the need of a recovery plan. A negative free surplus effectively shows that the known measures available to the fund are already insufficient to establish recovery. It clearly establishes that, should a hit be taken on its investments, it is ill-prepared in advance to deal with the consequences. The results in Table 3 specifically show that a pension fund that has a clearly defined indexation ambition (these are the cases 'base case', 'more equity' and 'no contribution and sponsor support') should define an additional steering instrument such as the ex-ante benefit steering, or adjust its existing policies in such a way that the liability options total less than its assets. All in all, we can conclude that the HBS can be a useful tool to assess whether the contract is 'sufficiently complete' to provide the necessary security (and transparency regarding this security) to participants. A supervisor could certainly use this tool in such way.

*Proposition 8: By assessing the free surplus under the HBS, the supervisor can decide whether the available measures to the fund are adequate to counter setbacks.*

## **5. Supervision based on the Holistic Balance Sheet**

EIOPA and the EC intend to use the HBS for supervision regarding the financial position of pension funds by setting HBS-related capital requirements. This raises the question how this can be done exactly. In this section, we will explore ways of structuring supervision based on the HBS.

### **5.1 Four key areas of supervision**

Kortleve et al. (2011) state the following goal of supervision: 'To what extent are the contribution policy, investment policy, sponsor commitments, and funding position of the pension fund in line with the benefits and risks communicated to all stakeholders in the pension fund?'

This supervisory goal is made up of two components: (1) assessment of the financial position of the pension fund and of the communication about the pension (fund) and (2) the funding thereof with all stakeholders. In both cases the HBS could play a role. Broeders et al. (2012) state that the supervisory authority needs to assess four key areas of attention of the pension fund to achieve the key objective of supervision:

- Financial health: to what extent is the pension fund able to live up to its communicated benefits, both now and in the future?
- Risk management: to what extent is the pension fund exposed to adverse developments, and are the available risk-mitigating measures sufficient and in line with the goals and level of risk aversion of the stakeholders?
- Disclosure: are the nature of the benefits and the related risks disclosed clearly and on a timely basis to all stakeholders?
- Governance: is the chosen form of governance fit for purpose and adequately organized?

In the following sections we will elaborate how the HBS can be useful in these areas.

### **5.1 Financial health**

It can be argued that the HBS is actually quite effective to monitor the capacity to achieve communicated benefits. In traditional supervision, we see that the lack of additional security mechanisms gives rise to recourse to different layers of supervision. In times of prosperity, the main supervisory instrument is a static 'snapshot' of the tangible assets and liabilities. When underfunded, however, most if not all supervisory regimes will switch focus to recovery plans that also include steering instruments. This will often also include expected risk premiums on the asset mix. In that case, both pension funds and supervisors feel the need to look beyond pure financial assets and liabilities. It seems inconsistent to only do so when pure financial assets fall short. The HBS offers the possibility to integrate all steering instruments into one single analysis. Theoretically this may even simplify regulation, removing the need to change external reporting and analyses in different situations.

*Proposition 9: The HBS merges different elements of supervision into one overall approach as a tool to enable consistent supervision for different funding situations.*

As the steering instruments typically represent a claim on the future, the HBS also provides additional insights into the future, including the ongoing ability to pay benefits. The HBS cannot, however, provide full insight into the future position. Future projections and sensitivity analysis will give some insight into the



consequences of changing conditions such as lower interest rates, weaker sponsors, or a different indexation policy. Broeders et al. (2012) conclude that the HBS cannot be the sole supervisory tool.

*Proposition 10: Future projections and scenario analysis, whether on the traditional or the holistic balance sheet, will always need to be a part of the supervisory toolbox.*

The advantage of the HBS is that it is able to include all steering mechanisms in a consistent way. Another way of assessing financial strength is a stochastic Asset Liability Management (ALM) study. In such a study the pension fund projects stochastic scenarios and looks at the likelihood and impact of possible scenarios. A disadvantage of an ALM study is that one has to compare the distribution of contributions with the distribution of benefits and make an assessment of the desirability of contribution increases (expressed in probability and amount) with benefit adjustments. The HBS can express these in monetary terms and one can add/subtract sponsor covenants with increased contributions that involve conditional indexation.

*Proposition 11: The HBS makes it possible to compare policy impacts in a single consistent manner, instead of comparing distributions of different steering variables.*

Finally, it is important to realize that supervision on the financial health of the pension fund is not necessarily the same as supervision on the benefits to the participants. In cases where benefits can be adjusted in response to financial shocks, the calculation of the SCR will show that the 'holistic funding ratio' is quite stable – indicating low risk for the pension fund – because

the surplus with the benefit reduction option substantially increases in value (see Section 4.2). Supervision can, however, not stop at this point: it is clear that this increase calls for additional information regarding the balanced distribution of reductions, the impact on purchasing power, and the awareness of participants of their perceived risks (see Section 5.1.3). This might be achieved by increasing the granularity of the HBS and breaking up the liabilities into different relevant subgroups (such as age cohorts and income groups). However, the increased complexity is a drawback. Much can probably be gained by establishing an explicit and complete pension contract.

*Proposition 12: Supervision solely applied to capital requirements is not enough to ensure proper supervision on the benefits and distribution of risks between stakeholders.*

### 5.1.2 Risk management

For risk management purposes, it is very promising to have different steering mechanisms all present on a single balance sheet. The relative size of the value of different steering mechanisms already provides much risk management information on the question to whom risks, both downside and upside, are assigned. Assigning the consequences of deviations from the expected trend to stakeholders and measuring the impact of shocks on their stakes is becoming more and more commonplace for pension funds. In the Netherlands, we have seen an increased interest on the part of pension funds and supervisors in the impact of policy, steering mechanisms, and recovery plans on stakeholders, with much attention for the impact of changes in the pension deal on generations (see Kortleve and Ponds 2006 and 2010). The HBS can play a role in this development, although

the first step will always be to formulate a more complete contract.

*Proposition 13: The HBS is a tool that can improve risk management and insight into risk sharing between stakeholders.*

The question to what extent the pension fund is exposed to adverse developments is strongly related to its ability to live up to communicated benefits. Again, future projections that give due attention to possible stress scenarios will always remain necessary to be able to properly assess future risks.

### *5.1.3 Disclosure and governance*

Disclosure is closely linked to financial health as well as to risk management. The assumptions used in the calculation of the HBS and in risk management should be fully aligned with the benefits and risks communicated to all stakeholders in the pension fund. Communication not only means sending the message, but also making sure that reasonable policyholder's expectations are being fulfilled by the pension fund (Kortleve et al. 2011). The perception of policyholders, who possibly do not fully understand the benefits promised and the risks and consequences for benefits and contributions, should be leading. Because of the inclusion of the steering mechanisms in the HBS, a first layer of additional information is added for the board and for members. However, most people will not be able to read and understand the HBS. Whereas members may be able to understand a traditional balance sheet, interpreting a HBS will only be for the few. The main governance challenges to overcome will be:

- Explaining the meaning of the value of the reported steering mechanisms. It will be difficult to explain that the option value of sponsor support is not equal to the actual money paid in, or that the option value of some conditional indexation measure is not the actual indexation granted to members.
- Explaining the consecutive changes from one HBS to another through time. A change in any option value can be caused by many different factors, and most probably a combination thereof. Underlying the change may be a change in real assets, a change in market risk perception, a change in model assumptions or methodology, or a change in underlying policies.
- Explaining the differences between the HBS and the traditional funding ratio.
- Explaining to pension members the SCR and its link to the communicated security level.

*Proposition 14: The HBS leads to increased complexity in communication, both to board members and participants.*

## **5.2 Issues with using HBS for prudential supervision**

In Section 5.1 we have outlined pros and cons of the HBS with respect to the goals of supervision (also see Broeders et al. 2012). We can add to this the lessons learned from our technical analysis in Chapter 3. We have argued that the degrees of freedom that apply to setting up an HBS are so large that more research is needed before the robustness and credibility of results can be properly assessed.

This wide dispersion of possible settings has serious consequences for the way the HBS can be used. What to think of two identical funds that happen to make different models or

parameter choices, whereby one is shown to be underfunded while the other is not? It seems impossible that regulatory consequences can be fully based on the HBS. That effectively opens up the possibility that regulatory action is not the consequence of actual policies and funding, but also of arbitrary choices turning out to be merely 'unlucky'. To take this one step further: it is conceivable that the model input is calibrated to reflect the outcome most suited for the fund.

This seems to call for far-reaching standardization on models and parameters, to prevent just that. From experience we know, however, that agreement on a standard set and methods are not always easy to reach, as illustrated by the Dutch commission chaired by Dr. F.J.H. Don on parameter setting for Dutch pension funds.

*Proposition 15: Regulatory arbitrage is a serious threat to the viability of the HBS as a tool in prudential regulation. This calls for standardization of valuation models and strict rules on the use of proprietary internal models.*

## 6. Conclusions

We have described in this paper some elements of supervision that would improve through use of the holistic balance sheet, but we have also encountered some shortcomings. It is not yet clear what the entire scope of the use intended by the European Commission will be. However, to initiate the discussion, we propose the following points of attention. See Appendix A for an overview of all propositions.

- From *Proposition 2* we have seen that the evaluation horizon can have great effect on the value of the steering mechanisms and therefore also on the resulting position of the pension fund. The longer the horizon, the less certain the value of steering instruments becomes, as it will increasingly depend on illiquid-market information, model assumptions, and subjective expert judgment. We propose to always calculate and look at two holistic balance sheets, one based on a short horizon and one based on a medium-term to long horizon. For the value of each steering mechanism, the difference between its short-term and long-term value may be considered as having a lower tiering towards the required security.
- From *Proposition 5* and *Proposition 6* we have seen that, depending on the exact situation, the resulting balance sheet is not an accountable number as is the case for a traditional balance sheet. On the one hand, more analysis should be undertaken as to what the confidence interval would be for a given value of a steering mechanism. On the other hand, more research on the valuation techniques is needed in order to improve the accuracy of the valuation. We expect, however, that a range of uncertainty will always remain. Standards for economic scenario generators are required to ensure compara-

bility between pension funds. As long as this is not the case, we advise that the HBS not be used as a sole measure of solvency, but rather as a first warning system.

- From *Proposition 10* we have seen that even though the HBS provides a complete picture of the current situation, it does not in itself provide information on the future development of the HBS, neither in an expected nor in a worst case situation. These analyses will thus remain necessary and should be included in the prudential framework.
- The HBS can summarize all steering mechanisms into a single number. This seems to make supervision rather easy, but from *Proposition* we know that this also removes any detailed information on how the number has been compiled. Two funds with the same net capital requirement can have very different levels of benefit security. Supervision should therefore always look through the HBS and assess the actual value and nature of the steering mechanisms.
- Combining *Propositions 13 and 14*, we can conclude that the HBS is a complex tool that has its merits for risk management. It would be worthwhile to examine whether the HBS can be used – at least during an introductory period, if and when introduced – between professionals or as an internal model to improve risk monitoring and policymaking, rather than introducing the HBS as the single (or most important) instrument for prudential supervision. In addition to pure risk management, the HBS could also be introduced as an internal model (voluntary or otherwise) with the possibility of capital relief as a consequence, as also proposed in Broeders et al. (2012). Getting professionals used to working with and understanding all the information incorporated in the HBS can already prove to be a challenge of its own, and an important one to overcome before extending its use wider.

## **Appendix A: Summary of all propositions made in this paper**

*Proposition 1: The different elements of the HBS have to be assessed jointly to account for mutual dependencies.*

*Proposition 2: The value of the steering mechanisms depends heavily on the evaluation horizon. In setting prudential supervision rules, one should be very careful when deciding on this horizon.*

*Proposition 3: Ex-post benefit reduction is best kept off balance or recognized as a balancing item with lower tiering towards a desired security level.*

*Proposition 4: Ex-ante benefit steering is an important element in making the pension contract complete, especially if there is no guarantor of last resort to honor promises.*

*Proposition 5: The hybrid nature of contingent claims embedded in pension contracts calls for the development of extensive models.*

**Proposition 6:** The construction of a valuation model for an HBS involves many different choices. All choices combined can lead to a wide valuation range for balance sheet items. More research has to be undertaken on this subject before an HBS can be used in prudential supervision.

*Proposition 7: The SCR calculation relies heavily on the accuracy and realism of the formulated policies. Inclusion of the loss absorbing capacity of steering mechanisms imposes high demands on the assessment of the policies.*

*Proposition 8: By assessing the free surplus under the HBS, the supervisor can decide whether the available measures to the fund are adequate to counter setbacks.*



*Proposition 9: The HBS merges different elements of supervision into one overall approach as a tool to enable consistent supervision for different funding situations.*

*Proposition 10: Future projections and scenario analysis, whether on the traditional or the holistic balance sheet, will always need to be a part of the supervisory toolbox.*

*Proposition 11: The HBS makes it possible to compare policy impacts in a single consistent manner, instead of comparing distributions of different steering variables.*

*Proposition 12: Supervision solely applied to capital requirements is not enough to ensure proper supervision on the benefits and distribution of risks between stakeholders.*

*Proposition 13: The HBS is a tool that can improve risk management and insight into risk sharing between stakeholders.*

*Proposition 14: The HBS leads to increased complexity in communication, both to board members and participants.*

*Proposition 15: Regulatory arbitrage is a serious threat to the viability of the HBS as a tool in prudential regulation. This calls for standardization of valuation models and strict rules on the use of proprietary internal models.*

## Appendix B: Correlation matrices used to calculate the final net and gross SCR

As proposed in the technical specification of the European Commission (EC 2012).

The market risk must be calculated for both an increase and a decrease in each of the components. With an interest rate increase, parameter A is set to 0; with a decrease it is set to 0.5.

i,j	Market	Default	Pension Liability	Health
Market	1			
Default	0.25	1		
Pension Liability	0.25	0.25	1	
Health	0.25	0.25	0.25	1

Table 4. Correlation matrix for the major risk categories

i,j	Interest	Equity	Property	Spread	Currency	Concentration
Interest	1					
Equity	A	1				
Property	A	0.75	1			
Spread	A	0.75	0.5	1		
Currency	0.25	0.25	0.25	0.25	1	
Concentration	0	0	0	0	0	1

Table 5. Correlation matrix for market risk.

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- 18 The holistic balance sheet as a building block in pension fund supervision (2013)  
Erwin Fransen, Niels Kortleve, Hans Schumacher, Hans Staring and Jan-Willem Wijckmans

## The holistic balance sheet as a building block in pension fund supervision

EIOPA proposed the holistic balance sheet (HBS) as a new and innovative way to assess all pension funds in a harmonised manner in its advice regarding the review of the IORP Directive (EIOPA 2011). In addition to traditional financial assets and liabilities, all steering mechanisms available to the pension fund should be taken into account. The HBS and the valuation of steering mechanisms are new concepts and so far only in the very early stages of development. It is therefore necessary to analyze whether the intended use is possible and what challenges lie ahead. In this paper, Erwin Fransen (PGGM), Niels Kortleve (PGGM), Hans Schumacher (TilU), Hans Staring (PGGM) and Jan-Willem Wijckmans (ABN AMRO) make a first assessment of the possibilities to use the HBS in pension fund supervision.