

Advisory Report of the UFR Committee

Ultimate Forward Rate Committee

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Summary and advice

In September 2012 the Ultimate Forward Rate method was introduced for Dutch pension funds. The main motivation for its introduction was to make the long end of the yield curve, which is used to determine the nominal funding ratios, less sensitive to financial market distortions. The result has been a more stable yield curve and by extension more stable funding ratios for pension funds. This is important as nominal funding ratios play a pivotal role in the financial strategies pursued by pension funds: the funding ratio among other things indicates whether there is scope for indexation of pensions, or how much need there is for reductions of pension rights and benefits. The Dutch State Secretary of Social Affairs and Employment installed the *Ultimate Forward Rate* (UFR) Committee to assess the current design of the UFR method and to provide advice on possible adjustments.

Committee mandate

The UFR Committee focused on the yield curve based on which nominal pension liabilities are valued. For liabilities that are not free of risk, the use of a risk premium is being considered as part of the review of the pension contract. The considerations underlying such a premium are not part of the Committee's mandate. Its mandate was to provide advice on three components of the UFR method, i.e. (1) the level of the UFR, (2) the point on the yield curve from which the UFR method becomes operative, and (3) the extrapolation method.

Current solutions

The Committee examined to what extent the proposals that are currently being discussed on a European level may be used as a reference. It has, however, concluded that the timing and nature of the developments in Europe offer insufficient basis for its advice about the UFR method with respect to Dutch pension funds. This is why the Committee opted to issue an independent subject-specific advice on the UFR curve for Dutch pension funds.

Assessment criteria

The Committee used six criteria in formulating its advice on the yield curve: *consistency with financial markets, consistency with scientific literature, transparency and replicability, stability, limitation of financial markets distortion, and explainability*. The Committee is aware of the fact that there may be tension between some criteria, but has nevertheless tried to reconcile them to the best of its ability.

Consultation of market and foreign experts

In formulating its advice, the Committee took due consideration of the outcome of a broad survey among financial market participants. A total of 18 major national and international market participants gave their opinion on various aspects of the swap market and the criteria that to their minds are important in determining the yield curve. On top of that, five foreign experts were consulted and their opinions were also included in the Committee's final advice.

The Committee's advice

The Committee advises to use a yield curve based on the following components:

1. A UFR level based on the 20-year *forward* rates realised in the previous 10 years. The outcome of this advice would be a UFR of 3.9% (at end-July 2013) ¹
2. A starting point for the UFR method at 20 years. The Committee does not view this point as the Last Liquid Point but as the *First Smoothing Point*.
3. From there, the adjusted forward rate converges to the UFR, but never reaches it. The extrapolation method also incorporates market data after the starting point. The weight attached to market data declines gradually.

(1) UFR level

The Committee advises to determine the UFR based on a monthly adjustable 120-month moving average of 20-year forward rates. The average is calculated to one decimal point on end-of-month basis. This averaging offers clarity to market participants about the level of the UFR well ahead of time. At end-July 2013, the UFR calculated and rounded off in this way came to 3.9%. If the UFR method that the Committee proposes were to come into effect on 1 January 2014, the 120-month average at end-December 2013 would be used as a yardstick. The Committee expects the UFR level at end-December 2013 to be around 3.9% as well.

The Committee believes the current fixed level of 4.2% derived from the European proposals mentioned above to be insufficiently substantiated. It prefers the use of market data to an estimate of the equilibrium value of the UFR based on macro-economic considerations, which in the Committee's opinion is surrounded by too many uncertainties.

(2) and (3) Starting point and extrapolation method

The starting point in the advised methodology cannot be seen separately from the extrapolation method. It is not the same as the Last Liquid Point (LLP), as currently used both in the market and the literature. The Committee prefers to use the term *First Smoothing Point* (FSP). All market data is used up to the FSP, after the FSP, market data is used to a limited

¹ In this document the 20-year forward rate is taken to mean the 1-year rate over 20 years. For further explanatory notes on the concept of the forward rate see section 2.2.

extent up to the LLP, and after the LLP market information is no longer used. The advised extrapolation method entails a gradual transition of the *forward* rates, in which all available market data is included in the yield curve.

The proposed method is consistent with the principles that the Committee finds important.

The Committee proposes that the provision of advice with respect to possible future adjustments to this UFR method is included in the mandate of the Parameters Committee, which is to provide advice every three years on a large number of parameters relevant for pension supervision.

In comparison with the current UFR method and based on the interest rate levels at end July 2013, the proposed method has a limited effect on the funding ratio and the contributions of an average pension fund. For an average pension fund, the funding ratio based on the proposed UFR method will rise slightly by approximately 1.1% as compared with the current UFR method. The effect on contributions of the proposed UFR method is also generally limited: for an average pension fund, contributions may decline slightly to very slightly. By extension, generation effects are also slight compared with the current UFR method: the proposed UFR method is fractionally more favourable for the older generations.

The proposed method has several characteristics and advantages relative to the current one that the Committee considers to be important:

- it is consistent with recent scientific literature;
- it is transparent and replicable;
- it is better substantiated and is consistent with market observations and wishes and with the perceptions of the foreign experts;
- The number of choices to be made using this method will be smaller: the level of the UFR is determined by a long-term moving average and no point on the yield curve needs to be selected from where the UFR is fully included.

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1. Introduction

The Dutch pension system is currently undergoing a process of fundamental reform. The system of supplementary pensions is faced with the problem of ageing, and its vulnerability has also been exposed by the credit crisis. In September 2012 the government introduced what is known as the September Pension Package. One element of this package was the introduction by De Nederlandsche Bank (DNB) of an Ultimate Forward Rate (UFR) for the calculation of pension liabilities in the interests of supervision. The valuation of pension liabilities had previously been based directly on market rates. However, as the information on market rates for long maturities was regarded as unreliable, it was decided to apply a UFR method. The UFR is the price at which the one-year rate can be fixed over the very long term. On the basis of market rates and this and other assumptions, a discount curve or yield curve can be determined for all maturities. A feature of this UFR curve is that the interest rate used for the valuation of pension liabilities tends to converge in the very long term to the level of the UFR. The UFR is set at 4.2% in the current proposals for the European Solvency II Directive. Once it has been ratified the Solvency II Directive will apply to all European insurers and will specify, among other things, the capital requirements to be met by them. DNB has chosen the same UFR of 4.2% for determining the value of the liabilities of Dutch insurers on 30 June 2012.

The introduction of the UFR method has helped to stabilise the yield curve used to calculate the value of pension liabilities with long maturities, thereby also reducing the volatility of the funding ratios of pension funds. In this way, the UFR method is helping to dampen the procyclical effect of the Financial Assessment Framework (FTK) to some extent, in so far as high or low interest rates have a temporary or cyclical character. If market rates are at a low level, application of the UFR method will result in an increase in actuarial rates for longer maturities. Conversely, where market rates are high, application of the UFR method will lower the actuarial rates for longer maturities.

The question that now arises is whether the present design of the UFR method is the most suitable. The Ultimate Forward Rate (UFR) Committee was established by the State Secretary for Social Affairs and Employment on 21 December 2012 to advise on this subject. In its report the UFR Committee presents its recommendations on how the UFR method can be defined in such a way that the UFR curve provides the best estimate of the current risk-free yield curve both for now and for the foreseeable future.

The Committee's advice focuses on the valuation of nominal pension rights. The Pensions Act (*Pensioenwet*) provides that these should be valued as nominal guarantees. The Committee's

remit does not extend to answering the more general question of how to value pension commitments that are not in the nature of a nominal guarantee, as contained in the proposed new real pension contracts. A feature of the present pension contracts in the Netherlands is that pension fund liabilities are confined to what are termed 'firm' or 'unconditional' commitments. This is a major factor in determining the sensitivity of pension funds to shocks in the financial markets, particularly since there is also a rule that these rights should be valued at the market rate. It makes the pension funds especially sensitive to fluctuations in the nominal interest rate, unless their investment strategy is designed to provide a hedge against interest rate fluctuations. This can be at odds with the pension fund's ambition of paying pensions that are indexed in the long term. This is one of the factors behind the wish to reduce procyclicality in the nature and valuation of the liabilities, for example by introducing real pension contracts.

The discount curve, as discussed in this report, has an important role within the Financial Assessment Framework as it is used to estimate the funding ratio and hence the financial position of a pension fund. This role has been defined by the legislator for various parts of the Financial Assessment Framework, namely for the amount of the required buffers, for the cost-effective contributions, for the need to reduce accrued benefits as part of a recovery plan, for calculating the value of the entitlement in the case of a switch to a different pension fund, for the continuity analysis which gives pension funds an understanding of their financial risks and for the interest rate risk that arises as a result of differences in maturities between liabilities and assets.

Most of the experts consulted by the Committee indicated they would prefer a UFR method to a valuation method in which market observations are used until 50 years and the interest rate for longer maturities is kept constant (the pre-September 2012 method). A majority of the respondents also stated that the use of a UFR curve would be susceptible to political interference. All of them were wary of methods that might increase the possibility of interference.

In accordance with its remit, the Committee answers three questions: 1) from what maturity on the curve should the UFR method be applied? 2) what should be the level of the UFR? 3) what form should the convergence path to the UFR take?

This report has the following structure. Chapter 2 deals with a few basic topics and examines the valuation of pension liabilities and the relationship with the UFR curve.

Chapter 3 describes the European context and indicates to what extent this can serve as a basis for the UFR method for Dutch pension funds. The Committee has carried out a survey to ascertain the views of market participants on the UFR and their perceptions of the liquidity of

the swap market. For this purpose the Committee prepared a questionnaire and sent it to a large number of market participants. The questionnaire is contained in Appendix 6. The Committee has also consulted some foreign experts. The questions put to these experts are listed in Appendix 5. Chapter 4 summarises the survey findings and the answers given by the experts.

The criteria applied by the UFR Committee in deciding on its recommendations are discussed in Chapter 5. These criteria guarantee a workable result.

Chapter 6 sets out the recommendations of the UFR Committee. Chapter 7 devotes separate sections to a more detailed consideration of each of the dimensions and thus explains the reasons for the recommendations made in Chapter 6. Section 7.1 examines how the level of the UFR should be chosen. Section 7.2 looks at the factors to be considered when deciding on the starting point on the curve for the UFR method. Section 7.3 examines the choice of convergence method. The technical details of this method are set out in Appendix 6.

Chapter 8 contains an analysis of how this method will impact pension funds and examines possible intergenerational effects. This chapter also reviews the Committee's recommendations in the light of the criteria set out in Chapter 5.

2. The valuation of pension liabilities and the relationship with the UFR curve

2.1 The basis

The Dutch pensions sector has been firmly in the spotlight for a good many years. Public opinion, politicians and academia are all increasingly concerning themselves with the pensions sector. That is a welcome development. The Dutch pension funds play a major role in the Dutch economy. Some 400 Dutch funds manage over 1,000 billion euros in pension assets, which exceed 165% of gross domestic product.²

Pension funds receive pension contributions from their members. This is how members of the pension fund build up their entitlement. Pension funds have the task of investing the contributions in such a way that there is a high degree of certainty that the pension promised to each of the members (the pension entitlement) can be paid out to them. Pension funds have to manage the invested assets over a very long period. Today's 30-year-olds can expect to live, on average, to the age of 82.³ In other words, a person aged 30 who is paying contributions now will build up pension entitlement which is not expected to start being paid out until many decades later.

Pension funds are responsible for honouring the (long-term) commitment to their members. A feature of current Dutch pension contracts is that the nominal pension rights are promised with a high degree of certainty. These rights are 'firm' or 'unconditional'. In addition, most funds try to ensure that pension rights are index-linked. However, indexation is discretionary and dependent on the pension fund's financial position. Once indexation has been awarded in any year, it is treated as an unconditional liability and valued as such. However, future indexation is not shown as a liability on the balance sheet of the pension fund.⁴ In order to honour the unconditional rights, the funds must also manage their assets in such a way as to take this into account. This is why the government has adopted rules in the Pensions Act to ensure that pension funds actually fulfil the promises they have made. Important aspects of these rules are the funding ratio, the discount curve, firm (i.e. unconditional) rights and soft (i.e. discretionary/conditional) indexation.

² Source: De Nederlandsche Bank.

³ Source: Statistics Netherlands.

⁴ When pension funds promise unconditional indexation the pension rights, including the indexation, are treated as liabilities. Market-consistent valuation differs from the valuation of nominal commitments in the sense that future inflation or wage growth must also be priced. The Committee's advice is therefore confined to commitments which are regarded as risk-free nominal rights.

The funding ratio is the ratio of the value of the assets of a pension fund (the invested pension capital) to the value of its liabilities (the members' pension rights). As such, it shows whether a pension fund is expected to be able to meet its nominal commitments. If the funding ratio is exactly 100%, there is, in principle, exactly enough money to be able to fulfil all of the accrued unconditional pension commitments. For people who are already retired, this means that their retirement benefits can be continued until they die. For people who are still working, this means that the pension rights they have accrued at that moment can be paid. This concerns only the unconditional rights, including past indexation of rights. It follows that where a funding ratio is exactly 100% there is, in principle, no scope to adjust pension rights to allow for (wage) inflation.⁵ A concept similar to the funding ratio is that of the technical provisions. The technical provisions are the capital that is expected to be necessary in order to meet all current commitments.

The Netherlands has decided that pension rights should be valued on a market-consistent basis. The same principles then apply to both sides of the balance sheet – assets and liabilities. The principle that liabilities should be valued on a market-consistent basis is laid down in the Pensions Act. The value of the liabilities then shows what funds are needed in order to meet the pension commitments. For this reason, if the pension right is a guaranteed payment in euros, the risk-free interest rate provides the appropriate discount rate.

If the commitments are discounted at the risk-free interest rate the next major question is what the discount curve for long maturities should look like, given that only limited market data are available on the risk-free interest rate for the long term. The Committee has attempted to answer this question.

To determine the nominal funding ratio it is necessary to calculate the value of the assets and liabilities of the pension fund as accurately as possible. As far as the assets are concerned, this value can be inferred from the market prices paid for them. To determine the value of the liabilities, future retirement benefits are discounted on the basis of the risk-free interest rate. This involves the use of a discount curve to determine the current value of future liabilities. This discount curve indicates for each maturity how the future liabilities should be discounted in order to convert the value of those liabilities to the present-day. As the liabilities may

⁵ Formally speaking, the minimum required funding ratio is slightly higher (approximately 105%). This is a consequence of the obligation to maintain a reserve for risks including biometric risks (such as longevity) and operational risks, as laid down in the Pensions Act and European legislation. The minimum required funding ratio is determined by the existence of investment risks and by management expenses and risks arising from the pension scheme, including pension for surviving dependants and occupational disability pension. The determination of the required minimum level of regulatory own funds implements a provision of the European IORP Directive.

mature in the very distant future, calculating their value is difficult because the market rates required for this purpose cannot always be determined with sufficient reliability.

2.2 Forward rate

The current yield curve is used to value pension liabilities. The structure indicates for each maturity the relevant spot rate in the market at that time.⁶ Another important concept in this connection is the forward rate. A forward rate is the rate of interest applying to a financial transaction that will take place in the future but the price of which is fixed in the market now. As the current yield curve comprises all possible maturities, it also indicates implicitly the forward rates for future periods. If the length of the future maturity is one year, the rate is referred to as a one-year forward rate or, in brief, the forward rate. The Ultimate Forward Rate (UFR) indicates the value of the forward rate in the very long term, in other words the one-year rate in the very distant future.

There is a connection between the forward rate and the expected future rate. A high forward rate generally reflects the expectation of a high rate of interest in the future. This follows from the choices made by market participants. Where there is a wide discrepancy between the forward rate and the expected interest rate, one of the parties will have an interest in not concluding the interest contract immediately, but instead waiting to see how high the interest rate actually rises. A wait-and-see approach does involve uncertainty since there is a chance that the interest rate may end up higher or lower than the forward rate now known. A forward contract therefore provides certainty immediately, in any event in nominal terms.

There are two factors that cause a difference between the expected rate and the forward rate, namely the interest risk premium and the convexity adjustment. These factors are explained in Appendix 9.

The nature of the pension commitment determines whether it is valued using a nominal or a real forward rate. The nominal rate is used for nominal commitments and the real rate for real commitments. A real commitment provides protection from inflation. The following section deals with the nature of the pension commitment.

⁶ This spot rate is the interest paid on a zero-coupon bond. Such a bond does not make periodic interest payments and generates a cash flow consisting of repayment and interest on the maturity date only. In view of this characteristic, it is possible to replicate the cash flows of the pension liability by means of a basket of zero-coupon bonds. For the purposes of market-consistent valuation the value of the pension liability should be equal to the value of the basket of zero-coupon bonds or, to put it another way, the cash flows should be valued on the basis of the spot rates applicable to the maturities of the flows.

2.3 Value and nature of the pension commitment

A transparent and unambiguous valuation of the pension funds' commitments to their members is an important basis for a sound and fair pension system. A correct valuation of the liabilities is necessary in order to determine the right funding ratio, which indicates not only how much scope there is for indexation but also whether it is necessary to reduce accrued rights and benefits. *The issue is therefore to determine how the value of the liabilities can be determined as accurately as possible.* The valuation of the liabilities also plays a role in determining the cost-effective contributions and the value of pension rights upon transfer to a different pension fund. This is explained in Box 1.⁷

It is important to distinguish between two concepts relating to the value of pension rights.

The first is the *value of the formal (legal) right*. The Financial Assessment Framework (FTK) provides that pensions should be guaranteed with a high degree of certainty. This means that pension funds should have sufficient funds to meet their commitments with a high degree of certainty. This is why the legal rights are defined as risk-free claims under the current Financial Assessment Framework. Owing to their risk-free nature these claims are discounted with the risk-free yield curve.⁸ The use of the risk-free yield curve is a consequence of funding theory: if a pension fund has a funding ratio of 100% it can, in theory, exactly meet its unconditional commitments by investing its capital in risk-free market instruments.⁹ With such an investment strategy the pension fund will make just enough return to fund all accrued rights. In other words, valuation is a consequence of the replication principle.¹⁰ Supervision focuses on the value of the formal (legal) claim.

⁷ The valuation of (long-term) liabilities is of great importance to insurers as well. However, this issue falls outside the Committee's remit.

⁸ The claims can be guaranteed with 97.5% certainty and are therefore not entirely risk-free.

⁹ This is on the assumption that the unconditional commitments are expressed in nominal terms (i.e. as a promised payment in euros), without indexation to allow for inflation.

¹⁰ This means that in a world without arbitrage opportunities the market value of a pension liability is equal to the market price of an investment portfolio which generates exactly the required cash flows in all future circumstances.

Box 1. Application of pension liability valuations

Pension liability valuations have at least three important applications. First, the value of liabilities is used to determine whether future liabilities can also be met without reducing rights and benefits and whether there is scope for indexation. Second, the yield curve in principle plays a role in determining the contributions, ensuring that rights are not purchased too cheaply and that there is no redistribution between new and existing rights. Third, the value of the commitments determines the value in the event of a transfer to a different pension fund or to an insurer. This is of great importance to people who change jobs and is therefore essential to a properly functioning labour market. Here, too, redistribution between new and existing rights must be prevented.

Second, there is the *value of the retirement benefits*. This is the value of the (future) pension that can actually be expected, taking account of factors such as benefit reductions and indexation. The value of the retirement benefit is therefore dependent on the content of the specific pension contract and the financial position of the pension fund. The value of the retirement benefit is influenced by the possibility and degree of indexation and benefit reductions and hence by all decisions and legislation that have a bearing on this. Examples are the choice of investment strategy, the level at which contributions are set, and the rules that specify when reductions must be made or indexation may take place. The value of the promised retirement benefits can, in general, only be determined by simulation because there are countless factors that influence this. Simulation also makes it possible to see how changes in legislation and the pension contract will affect the different generations.¹¹

The description of the Committee's tasks refers to the determination of 'an yield curve that provides the best possible approximation of the risk-free interest rate'. The Committee's remit is therefore not related directly to the (economic) valuation of pension commitments, but instead concerns the value of the formal (legal) claim.¹² This is one of the most important building blocks of the actual pension contract and therefore ultimately decisive for the actual retirement benefits that can be expected.

¹¹ Netherlands Bureau for Economic Policy Analysis (CPB), 30 May 2012, *Generatie-effecten pensioenakkoord* (Intergenerational effects of pension agreement).

¹² The discounting method proposed for real contracts in the outline memorandum of May 2012 is based on the netting of a risk-free nominal yield curve, a deduction for indexation and an addition for investment risk, increasing with the horizon. The determination of the risk-free curve will therefore indirectly affect the determination of the economic value of high-risk commitments.

2.4 Market-consistent valuation

In many cases the value of the funds needed to meet a commitment can be exactly determined from observed prices on financial markets. An example would be a commitment to pay a fixed nominal amount monthly over the next five years. The value of this commitment is determined by the value of the risk-free bonds that will generate the cash flow. As a liquid and fully-fledged market exists for these bonds, making the valuation is simple in this case.

Often, however, additional assumptions are necessary in order to estimate the value. If these assumptions are made in such a way as to be consistent with the observed behaviour of financial markets, the valuation is described as *market-consistent* (see also Box 2).¹³ This applies in situations where markets do not exist or provide few reliable prices. An example would be the valuation of a commitment to pay until death a monthly amount which is not subject to benefit reductions or indexation. This differs from the first example in that the value of this commitment is determined in part by an estimate of the mortality risk and a fee for the insurer for bearing the longevity risk.

One of the problems in determining the value of guaranteed pension commitments in the very long term is whether the observed prices of very long-dated bonds provide a good approximation of the market value of these pension liabilities. This is because in the case of very long maturities prices are not available or available only for relatively small transactions. It follows that a discount rate based purely on market data is highly sensitive to supply and demand shocks, as is the valuation of the liabilities. This causes volatile funding ratios, which can in turn result in unnecessary reductions of retirement benefits or in unwarranted indexation. Such decisions are therefore based on insufficiently reliable data.

¹³ It should be noted that market valuation and market-consistent valuation do not therefore generally coincide with discounting with a risk-free yield curve (e.g. where there are risk-bearing commitments).

Box 2. Calculation of a market-consistent value

It is apparent from scientific literature that the market-consistent value of a pension commitment can be determined by various equivalent methods. Examples are the discounting of the expected pension benefits with the expected return on the funds that offset this commitment, risk-neutral discounting and the use of simulation techniques. In the case of a risk-neutral valuation the discount rate is the risk-free interest rate, which contrasts with discounting with the expected return in the case of the first method. The two methods produce the same outcome provided that the numerator and denominator are consistent with each other. Talking about the discount rate without also specifying what quantity is being discounted is therefore pointless and can cause confusion.

2.5 Effect of changing the valuation system

To guarantee that they can always meet claims, pension funds are required to have sufficient capital to generate an adequate return when converted into risk-free investments (such as risk-free government bonds). The Financial Assessment Framework provides that pension liabilities are valued by reference to the risk-free yield curve. Pension funds may take greater investment risks, but must have sufficient means to be able to meet their unconditional liabilities with 97.5% certainty (over a one year horizon). To satisfy this certainty requirement, pension funds must keep a buffer whose size increases in proportion to the investment risks taken by them. If underfunding nonetheless occurs, this difference must be made good within the statutory recovery period.

2.6 Advantages and risks of the UFR curve

On the basis of the existing economic literature and the above analysis the Committee has identified a number of possible advantages and disadvantages of using a UFR curve.

The advantages of a UFR curve are as follows:

- A UFR curve prevents a situation in which the value of the liabilities – and hence the funding ratio and the cost-effective contributions – is calculated on the basis of insufficiently reliable market rates, provided that the UFR curve itself is determined in a reliable and market-consistent manner.

- The observed long-term rates will generally be lower than the UFR rates in times of economic adversity and higher during times of growth.¹⁴ The UFR method dampens the procyclical effect of the Financial Assessment Framework.
- The volatility of the liabilities' value is reduced through application of the UFR method, and the funding ratios become less sensitive to the actions of individual market participants.

The risks of a UFR curve are as follows:

- Three important parameters are determined by reference to criteria that are not fully objectifiable, namely the level of the UFR, the point on the curve at which the UFR method starts, and the interpolation method. This requires a discretionary choice which can be reviewed periodically. It is impossible for pension funds to hedge against changes in the UFR method.
- The present estimates of the UFR, the starting point on the curve for the UFR method and the convergence path may be wrong. This would mean that the funding ratios are overestimated or underestimated.
- There is a risk of market distortions affecting the starting point of the UFR method.
- The value of a pension fund's liquid assets is entirely determined by the market and that of its illiquid investments is determined in a market-consistent manner. Since a pension fund's liabilities are valued by means of a UFR curve, their value is not determined entirely by the market. This creates an asymmetry in the balance sheet of pension funds.
- Use of the UFR curve means that hedging the interest rate risk becomes more complex and costly.

¹⁴ Naturally, this does not mean that low long-term rates are always a consequence of an economic crisis. Lower rates may also be structural, for example due to lower structural growth, structurally lower inflation or structurally lower risk premiums.

3. European and international context

Achieving the optimal design of the discount curve for the liabilities of pension funds and, in particular, the UFR method is not an exclusively Dutch concern. In this chapter the Committee deals with two questions: how do matters stand with the UFR method in Europe and how does Dutch policy on the valuation of pension liabilities relate to policy in other countries? This is in keeping with the Committee's remit: namely to examine whether and, if so, to what extent the UFR method can take account of European developments.

3.1 Developments in the European Union

The Solvency II Directive for insurers was published in 2009. In Solvency II the discussion about the UFR method (in particular, the Last Liquid Point (LLP)¹⁵ and the convergence period) is part of the Long-Term Guarantee Assessment (LTGA). This is mainly an assessment of the quantitative effects of various modified variants of the yield curve. This impact analysis has caused delays and uncertainty in the introduction of the capital requirements of Solvency II. It was expected that Solvency II would be introduced in 2014. As a result of the discussion and uncertainty about the yield curve, it is becoming increasingly debatable whether the introduction can even take place in 2016. Further postponement to a date later than 2016 is not unlikely. EIOPA published the results of the LTGA on 16 June.¹⁶ The following sections deal with the main parts of the LTGA relating to the yield curve within Solvency II and hence the UFR: the extrapolation method, the matching adjustment and the adjusted curve.

3.1.1 Extrapolation to the UFR

The UFR method is used to determine the yield curve. Convergence periods of 10 and 40 years from the LLP were examined. An LLP of 20 years, which was previously chosen in a European context, did not really feature in the LTGA discussions.

In the European context the Smith-Wilson method is used for extrapolating to the UFR. This specific method ensures that no post-LLP market data are used for input. This creates great interest rate sensitivity around the LLP. Dutch academics and professionals have also drawn attention to this drawback.¹⁷ Indeed, in September 2012 this prompted DNB to construct a modified method for pension funds to extrapolate to the UFR. This involves using post-LLP

¹⁵ The Last Liquid Point is the last point at which the market is still completely liquid and no market distortions occur: market observations are representative. This is often seen as the starting point on the curve for the UFR method. This concept is defined in more detail in section 7.2.

¹⁶ See <https://eiopa.europa.eu/consultations/gis/insurance/long-term-guarantees-assessment/index.html>.

¹⁷ See, for example, Kocken et al. (2012), Bovenberg et al. (2012) and the Dutch Actuarial Association (2012).

market data as input, thereby substantially reducing the interest rate sensitivity around the LLP. Many pension funds had in fact indicated that they wished to hedge the UFR curve, which is difficult to do when applying the Smith-Wilson method.

3.1.2 Matching adjustment

Matching adjustment (MA) involves calculating part of the technical provision at an interest rate matched to the investments present. The MA thus ensures that changes in the interest rate do not affect the extent of the cover provided by the matched investment. The MA is intended for long-term insurance products with a predictable cash flow against which the insurer can set off long-term investments with a similarly predictable cash flow. The underlying reasoning for applying an MA is that when investments are kept until maturity, price fluctuations that occur in the meantime become less relevant. It also makes a correction for the fundamental credit risk of these investments.

3.1.3 Adjusted curve

The adjusted curve in the LTGA impact study is designed to make a temporary correction in the event of special market conditions. For various reasons (such as possible procyclical behaviour among insurers and the supposed illiquidity of investments which insurers may acquire) it may be desirable for the risk-free base curve to be adjusted by EIOPA in special circumstances.

3.2 Revision of the IORP Directive

The first Directive on Institutions for Occupational Retirement Provision (IORP) was adopted in 2003. This directive may be viewed as a first step towards harmonisation of the pensions market in Europe.

EIOPA has recently carried out a Quantitative Impact Study (QIS) to determine the effects of a possible application of a revised IORP Directive for pension funds based on Solvency II. This concerned, above all, the application of the capital requirements under Solvency II. As such, the QIS was mainly intended to assist the European Commission in making the choices involved in a revision of the Directive. This QIS, in which seven countries took part, showed that as a result of the application of the Solvency II capital requirements many pension funds would find themselves with a significant shortfall in comparison with the present situation.

On 23 May 2013 the European Commission decided that in revising the IORP Directive it would confine itself to the provisions on governance, transparency and reporting requirements. For the time being it does not wish to raise the subject of capital requirements, as this would

require further study. It is expected that this further study will be undertaken by the next European Commission, because the present Commission's term of office ends in late 2014.

Box 3. Danish and Swedish application of the UFR.

In Denmark the liabilities of both pension funds and insurers¹ are valued using the euro swap curve plus the spread between Danish and German government bonds. This is because the liabilities of Danish pension funds and insurers are denominated in Danish kroner, and a curve based on Danish market data must therefore be used. The curve contains a correction to make it more hedgeable.

As market participants bought Danish government bonds on a large scale towards the end of 2011, their spread fell below that of German government bonds and consequently ended up below the euro swap curve. The Danish discount curve formula made no provision for this situation.

On 8 December 2011 the Danish financial regulator (FSA) decided to introduce a floor for the spread between Danish and German government bonds to ensure that the discount curve is at least equal to the euro swap curve and is increased by a positive spread between Danish and German government bonds.

On 12 June 2012 the Danish finance minister decided, in anticipation of Solvency II, to apply the discount curve in combination with measures to limit dividend payments and enhance transparency.

The UFR has been set at 4.2%, the LLP at 20 years and the convergence speed at 10 years (in accordance with amendments by the European Parliament, but contrary to the European Commission's proposal of 40 years). Other technical elements are in conformity with EIOPA's proposed technical specifications. The spread between Danish and German government bonds is implicitly taken into account in the extrapolated part of the curve.

¹ In Denmark the same statutory framework applies to insurers and pension funds. Pension products are often in the nature of individual defined contribution products and guarantee or life products.

(contd.)

In Sweden the liabilities of insurers and pension funds are valued using the interest rate on Swedish government bonds. This is because the liabilities are denominated in Swedish kronor, and a curve based on Swedish market data must therefore be used.

On 5 May 2013 the Swedish financial regulator (FI) proposed that from 31 December 2013 the liabilities of insurers should be calculated using a discount curve that would serve as preparation for Solvency II. The FI made this proposal in order to increase stability and predictability for insurers and thus protect the insured. The proposal contains an LLP set at 10 years, after which the curve will converge to the UFR.

The Danish and Swedish decisions to anticipate the Solvency II framework as regards the UFR has to be viewed against the background of the statutory framework for insurers and pension funds in those countries (they are identical) and the fact that the use of their own currency entails illiquidity in the present market conditions. This does not apply in the Netherlands. This is why it is not possible simply to draw a parallel between the Netherlands on the one hand and Denmark and Sweden on the other.

3.3 Discount curve in individual EU Member States and outside the EU

It appears from a more wide-ranging international comparison that the Netherlands' use of the risk-free interest rate in valuing liabilities does not differ substantially from the practice in other countries. Table 1 shows the findings of a survey by the Committee of European Insurance and Occupational Pensions Supervisors (CEIOPS) in 2008.^{18/19} Four countries apply a fixed discount rate, five apply a current risk-free market rate or yield curve (including the Netherlands), eight make some provision for expected returns on investments to be included in the discounting and three base themselves on the Life Directive.²⁰ It should, however, be noted that the nature of pension contracts is not necessarily the same in the different countries. In other words, the presented discount rates are not entirely comparable with one another. Box 3 above deals with the situation in Denmark and Sweden and Box 4 below with the situation in Switzerland.

¹⁸ CEIOPS is the predecessor of EIOPA.

¹⁹ For the survey, see https://eiopa.europa.eu/fileadmin/tx_dam/files/publications/submissionstotheec/ReportonFundSecMech.pdf

²⁰ This means that the discount rate per maturity may not exceed 60% of the interest rate on government bonds with same maturity of the country concerned. Pension funds may also choose a lower discount rate.

Table 1. International use of valuation methods for pension commitments²¹

	Austria	Belgium	Germany	Germany	Denmark	Spain	Finland	France	Greece	Ireland	Italy	Lithuania	Luxembourg	Malta	Netherlands	Norway	Portugal	Sweden	United Kingdom	number
Fixed discount rate (max.)																				4
Current risk-free market rate																				5
Expected returns on investments																				8
Life directive																				3

3.4 Why deviate from Solvency II?

The Committee considers that the current plans for the introduction of a UFR method in Europe provide insufficient basis at present for advice on the UFR method to be adopted for Dutch pension funds. The Committee has therefore decided to make its own independent financial and economic recommendations on the UFR curve for Dutch pension funds. There are two major reasons for this.

First, it is debatable whether it is still appropriate to base the UFR method on the method being developed in the context of Solvency II, the supervision framework for insurers. This is because the date of implementation of Solvency II has become very uncertain: 2014 is very probably no longer feasible and an introduction date from 2016 onwards seems more likely. Moreover, the European Commission has recently announced that it has decided to postpone for the time being the introduction for pension funds of the capital requirements under this framework, of which the UFR method is part.²² In revising the IORP Directive the European Commission wishes to concentrate for the present on strengthening governance, transparency and reporting requirements for pension funds. In other words, since the UFR for pension funds was introduced in the Netherlands (in the autumn of 2012) it has become less apparent why the UFR method for pension funds should be based on a European framework for insurers.

²¹ Germany has been included twice as it has two sets of supervision rules for pension funds. In Luxembourg there are two supervisory authorities, each of which supervises part of the pensions sector.

²² Speech of Michel Barnier, the EU Commissioner for Internal Market and Services, on 23 May 2013; see also memo/13/454 of the European Commission.

Second, the various parts of Solvency II are closely interrelated both substantively and in terms of decision-making. Within the framework of Solvency II the UFR method is part of the broader question of how insurers' long-term liabilities should be valued. The use of a UFR method under Solvency II has both advantages and disadvantages in comparison with the use of the risk-free interest rate. Singling out the UFR method from this more wide-ranging approach creates the risk of cherry picking. Nor is this risk confined solely to elements of the valuation of long-term liabilities: the entire intended framework is different for insurers than for pension funds (e.g. in relation to the confidence level of 99.5% which applies to insurers). Finally, it should be noted that the UFR method in Solvency II is part of a political process which often involves trade-offs between different parts of proposals. For these reasons it would not be appropriate to take an element from the Solvency II framework out of context.

Finally, the Committee considers that it is necessary to consider not only whether and, if so, to what extent the European context is relevant to the UFR method in the Netherlands, but also whether ideas on this subject developed in the Netherlands may in turn have an impact in the European debate. An example would be the possible adjustment of the Smith-Wilson method in accordance with that made by DNB in September 2012.

Box 4. UFR in Switzerland

The Swiss financial regulator FINMA introduced a UFR discount curve for insurers and pension funds in 2011. The method (the Smith-Wilson method) and the parameters of this curve are in line with EIOPA's proposals, save for the following two factors:

- Since the Swiss discount curve is based on government bonds, the UFR has been fixed 0.3% lower than in EIOPA's proposals.
- FINMA uses different parameters for different currencies. For example, it has adopted an LLP of 30 years and a UFR of 3.9% for the US dollar and the euro and an LLP of 15 years and a UFR of 2.9% for the Swiss franc.

The reason given for fixing the UFR for the franc at this lower level is the low rate of inflation (and the related lower nominal yields) in Switzerland.

4. Survey among market participants and experts

The Committee approached a number of market participants and invited them to take part in a survey of the liquidity of the market for interest rate swaps and other matters. This is relevant because the degree of liquidity determines the maturity from which the extrapolation or convergence method should start. The reactions of market participants have been summarised in section 4.1 below. To get a better understanding of the theoretical financial aspects of the valuation of pension liabilities and the application of a UFR method, the Committee has also consulted a number of foreign experts. This is in keeping with the Committee's remit. The experts' responses have been summarised in section 4.2 below. The Committee has also consulted stakeholders of the Dutch pension funds in order to form an impression of their views on the UFR method. For more information about this see Appendix 4 to the report.

4.1 Survey among market participants

4.1.1 Design of the survey

The parties invited to take part in the survey together form a representative sample of national and international players in the market for interest rate swaps. These market participants include merchant banks, (Dutch) pension providers, firms of actuaries and consulting firms. An important aim of the survey is to examine where, in the opinion of the respondents, the LLP occurs. The LLP is generally taken to be the last point where there is still enough liquidity for a reliable market observation to be made: in other words, the point where there are still enough dealers and still enough trades taking place. In addition, the Committee framed a number of more detailed questions to gauge the respondents' views on the UFR method.

The survey consisted of questions about the LLP, the concept of liquidity both in general and in relation to contracts with very long maturities in particular, how the respondents view the concept of UFR and the present implementation by pension funds. The survey is contained in Appendix 6. A total of 16 respondents answered the questionnaire.²³ Below are the main findings from the survey for each individual subject.

²³ Two of the eighteen organisations invited to complete the questionnaire did not respond.

4.1.2 Findings of the survey: LLP

The majority of the respondents state that if they have to choose an LLP they would set it at 30 years. Periods of 50 and 10 years are also mentioned as LLPs. Often the respondents indicate that the market is extremely liquid up to 10 years and that the liquidity for 20 and 30 years swaps is the same. After 30 years, liquidity declines sharply. According to the majority, the LLP is stable and has been at the same point for at least the last five years. They also state that since the financial crisis liquidity as a whole has fallen slightly. According to most of the respondents, there were no liquidity problems before this.

4.1.3 Findings of the survey: liquidity

Liquidity in the euro swap market is measured by all respondents in accordance with at least one of the following two methods. Two thirds describe the euro swap market as liquid if the transaction costs are low and/or the bid-offer spread is small.²⁴ Three quarters state that the main determinant of liquidity is whether large transactions are possible without distorting the market. As many point out, however, this last condition is hard to measure, mainly because it can only really be tested if a large transaction takes place.

Other indicators mentioned by the respondents are the market's reaction speed, equal numbers of sellers and buyers and the presence of an underlying, risk-free bond market.

In summary, liquidity is about the possibility of trading with low transaction costs and without causing a noticeable impact on the market.

4.1.4 Findings of the survey: other observations

The respondents were also invited to provide any comments or suggestions that might assist the Committee in drawing up its report. Below are some of these observations:

- Liquidity does not suddenly decline after a specific maturity point has passed. It would therefore be worthwhile taking account of market data beyond the LLP when determining a risk-free yield curve.
- Attention is drawn to the possible influence of legislation (or changes in legislation) on price formation in the swap market. For example, the introduction of the UFR for insurers and pensions funds has had a demonstrable effect on the market beyond the LLP (20 years).²⁵

²⁴ Transaction costs are defined as the bid-offer spread or the realised price in relation to the average of the bid and offer price. According to the respondents, the average transaction costs for a swap transaction of normal size are less than 1 basis point. This is higher (usually double or more) for large transactions.

²⁵ For example, the spread between 50 and 20-year yields has risen sharply since the introduction of the UFR for insurers and pension funds, which may be an indication that the market for long maturities is tracking the UFR.

- An LLP of 20 years automatically results in lower liquidity after this point. If the LLP were raised to, say, 30 years, liquidity would in all probability rise again for maturities of up to 30 years.
- Many market participants view the imminent legislation on the use of over-the-counter derivatives as a threat to market liquidity. Certain measures intended to improve market regulation and reduce systemic risks may push up costs and thus reduce liquidity. Measures mentioned as examples are the central clearing of derivatives, the financial transaction tax, the initial margin obligation for bilateral derivatives and the Basel III and MiFID Directives. As market liquidity is not stable over time, regular evaluation of the UFR method is necessary.
- The subject of the suitability of the LIBOR/EURIBOR swap market as a basis for determining the risk-free yield curve for the valuation of pension commitments has not been raised by the respondents for the time being. As a consequence of the credit crunch, however, the Overnight Index Swap (OIS) market, based on the Euro OverNight Index Average (EONIA), is rapidly gaining in popularity, partly due to the recent introduction of a central clearing system between banks in which only cash is permitted as collateral. The related valuation curve is the OIS curve. Since the credit crunch there has been a widening spread between the EURIBOR and OIS curves, which may point to an increase in the credit risk of EURIBOR swaps.

4.2 Consultation of experts

The Committee found five foreign experts willing to give their professional view on six questions. These experts were also asked to comment on the Committee's basic criteria. More about this can be found in Chapter 5. The questionnaire submitted to the experts is contained in Appendix 5. The comments are summarised in this section.

4.2.1 Use of UFR curve

In general, the experts prefer a UFR method to a valuation method based on market observations for up to 50 years and thereafter a constant rate of interest for longer maturities (the pre-September 2012 method). According to one of the experts, however, it is better not to use a UFR and instead to keep using market observations. This is contradicted by another expert who says that the use of a UFR curve is the only credible method. Most respondents indicate that it is not possible to keep using market observations for all maturities because market instruments cease to be traded after a particular horizon. The best option would be to use market observations until an LLP and thereafter either to extrapolate the forward rates or keep them constant. However, the experts also point out that choosing such an LLP is difficult: such a point is probably variable or possibly not even a single point but an interval in which liquidity gradually decreases.

A majority of the respondents indicate that the use of a UFR curve is susceptible to political interference. All of them are extremely wary of methods that could increase the possibility of interference.

4.2.2 Pension liabilities valuation method

According to the experts, unconditional pension liabilities should be valued on the basis of a risk-free yield curve. They consider that no sound economic reason can be given for the proposals to use a fixed rate or the expected return on investments for valuing unconditional pension liabilities. Discounting with a fixed rate or the expected return on investments is at odds with the nature of the unconditional pension commitment. The experts also consider that a fixed interest rate gives too much power to the supervisory authority.

4.2.3 EIOPA's estimate

The European Commission has fixed the UFR at 4.2%. The majority of the experts disagree with EIOPA's reasoning because:

- the long-term rates are lower than the rate used by EIOPA;
- historical bond interest rates (which form the basis of the European framework) say little about the forward rate;
- EIOPA has ignored the first half of the 20th century in its analysis of interest rates;
- aggregating the inflation rate and the real interest rate is not correct

However, the experts do praise the transparency of EIOPA's method.

There is no agreement among the respondents about which method would be right. Most indicate that they cannot immediately suggest a better alternative.

4.2.4 Liquidity

The experts differ in their views on the existence of an LLP. Two experts state that a market for products with very long maturities does exist. Others envisage an LLP of between 15 and 30 years.

4.2.5 Extrapolation and weighted market data

The majority of the experts consider that if a method is used in which market observations are given different weights for different maturities, the weight given to the market observations should gradually decline.

4.2.6 *Other considerations*

The experts make a number of suggestions unrelated to the questions. These are set out below on a point-by-point basis:

- ensure that the method is transparent and based on economic principles;
- use market data even beyond the LLP;
- test the proposed method by reference to historical market data;
- ensure that any intergenerational effects are properly calculated;
- distinguish between observation of the yield curve over liquid maturities and the extrapolation to the UFR.

5. Basic criteria

The Committee applies six basic criteria in deciding what constitutes a sound UFR curve. It considers that a UFR method which fulfils these conditions provides a good approximation of the risk-free interest rate in the long term. The external experts asked by the Committee to comment on these criteria have broadly endorsed them. Relevant observations have been briefly discussed in section 5.7 below. One of the experts wishes to add an extra basic criterion, namely intergenerational equality. This suggestion is considered by the Committee in Chapter 8. In that same chapter the Committee's advice is reviewed in the light of the basic criteria.

The Committee is aware that there may be tension between some of the criteria. For example, putting more emphasis on consistency with financial markets may be at the expense of stability and vice versa.

5.1 Consistency with financial markets

The UFR curve should be as consistent as possible with market data: only in the absence of reliable market data should the discount curve be adjusted.

5.2 Transparent and replicable

The manner in which a UFR curve is constructed must be properly explainable and also replicable, in any event for professional market participants and experts. This means that the manner in which a UFR curve is constructed should be relatively simple and transparent.

5.3 Consistency with scientific literature

The manner in which a UFR curve is constructed must be consistent with any recent ideas that have gained widespread acceptance in academic circles. Naturally, this applies to all important aspects of the UFR method, such as the level, starting point and extrapolation.

5.4 No distortion of financial markets

A UFR curve must be constructed in such a way as to cause minimum distortion to the operation of financial markets or financial institutions.

When the UFR method was introduced for pension funds and insurers, pension funds in particular indicated that they would like to have a UFR method which could be incorporated relatively easily into their strategy for hedging interest rate risk. Naturally, pension funds are not obliged to base this strategy on the UFR curve rather than on market rates. Accordingly, a substantial number of them do not do so in practice. In determining the value of their pension liabilities for official purposes, however, pension funds have no choice and are required to apply the UFR curve.

5.5 Stability

Both the method for determining a UFR curve and other parameters should be relatively stable. This is already implicit in the nature of the UFR: an ultimate forward rate will not be adjusted for every market change. The ultimate forward rate is determined by reference to longer-term projections. This also means that the actual forward rates may be either lower or higher than the UFR and the convergence path over a longer period. This may help the discount rate to have an anti-cyclical, stabilising effect on the system.

The extrapolation method should also produce a stable and robust yield curve which is in keeping with current market conditions and reflects the economic expectations for long-term rates.

5.6 Internationally sustainable

A UFR method must be designed in such a way as to be in keeping with international developments relevant to the Netherlands, for example developments in the European Union. Any significant differences must be explainable.

5.7 Comments of foreign experts

- One of the foreign experts notes that the continuation of the forward rate after a given maturity (flat forward curve) meets the first four basic criteria.
- One of the foreign experts considers that the criterion concerning possible distortions in financial markets is less important, and argues that markets are accustomed to taking government regulatory intervention in their stride and will always achieve an equilibrium. This expert believes that markets use all data as input in setting prices; government intervention is simply an extra item of information.
- One of the foreign experts observes on the subject of the stability criterion that it is normal for the value of pension liabilities to fluctuate in line with movements in the market. This expert notes that political management is undesirable here and suggests that the valuation be determined on the basis of fundamental economic considerations. Although, in the interests of stability, a method of dampening the

effect of these movements in benefit reductions and indexation can be chosen for political reasons, the expert in question considers that this should not influence the valuation.

- One of the experts consulted praises the responsible and prudent manner in which the Netherlands has hitherto dealt with the valuation of liabilities. This expert urges that it should continue to play a leading role by ensuring that valuations remain close to market valuation.

6. Advice of the UFR Committee

The Committee's remit was to advise on three aspects of the UFR method: (1) the level of the UFR, (2) the point on the yield curve at which the UFR method becomes operative, and (3) the extrapolation method.

In Chapter 3 the Committee has explained how it views the proposals currently under discussion in Europe. It has concluded that in view of the timing and nature of the developments in Europe these proposals currently provide an insufficient basis for advising on the UFR method. This is why the Committee has decided to make its own independent substantive recommendations on the UFR curve for Dutch pension funds.

Chapter 5 describes the six assessment criteria which the Committee has used as a guide in making its recommendations: *consistency with the financial markets, consistency with the academic literature, transparency and replicability, stability, limitation of financial market distortion, and explainability.*

As explained in Chapter 4, the Committee has consulted external experts and relevant market participants and taken their views into account in preparing the following advice.

Proposal

The UFR Committee recommends an yield curve based on the following elements:

1. A UFR level based on the average of the realised 20-year forward rates in the previous 120 months. This recommendation implies a UFR of 3.9% (at end-July 2013).
2. A starting point of 20 years for the UFR method. The Committee regards this point not as the LLP but as the FSP.
3. From the starting point onwards, the forward curve converges to the UFR without ever reaching it. As the extrapolation method allows for market data to serve as input even after the starting point until a maturity of 50 years, this maturity is designated as the LLP. The weight given to market observations after the FSP gradually declines.

(1) UFR level

The Committee recommends that the UFR be set on the basis of a monthly adjustable 120-month moving average of 20-year forward rates. This average is calculated to one decimal place on an end-of-month basis. This averaging ensures that market participants have clear information about the expected level of the UFR well in advance. The rounded UFR calculated in this way was 3.9% at 31 July. If the UFR method proposed by the Committee were to be introduced on 1 January 2014, the 120-month average at end-December 2013 would serve as the yardstick. The Committee expects the UFR level to be around 3.9% on this date too.

In the Committee's view, the arguments put forward for the current fixed level of 4.2% derived from the European proposals mentioned above are insufficiently cogent. The Committee prefers the use of market data to an estimate of the equilibrium value of the UFR based on macroeconomic considerations, which the Committee believes to be surrounded by too many uncertainties.

(2) and (3) Starting point and extrapolation method

The starting point for the recommended method cannot be seen in isolation from the extrapolation method. The starting point is not the same as the Last Liquid Point (LLP), as currently used in both the market and the literature. The Committee therefore prefers to talk about a First Smoothing Point (FSP). Liquidity does not suddenly decline after a specific maturity point has passed. The recommended extrapolation method entails a gradual transition of the forward rates, in which all available market data up to a maturity of 50 years (the LLP) serve as input in determining the yield curve.

The Committee sets the FSP at 20 years and the LLP at 50 years. It notes that the market participants see no great difference in liquidity between 20 and 30 years, but have observed a clear decline in liquidity after 30 years. The Committee considers that the method should be based on the market up to 20 years since this is sufficiently liquid and also that the market should not be completely disregarded after this period. The weighting of maturities after this 20-year point declines in the extrapolation method, which attaches great weight to the 25 and 30-year points, among other things. This choice makes it possible to ensure that interest rate sensitivity is concentrated at the start of the method and is spread over a longer period. This helps to limit any market distortion caused by the method.

The extrapolation method is applied from the FSP onwards. Until the FSP is reached the nominal (zero coupon) yield curve is based on the yield curve for euro swaps for maturities of 1 to 10, 12, 15 and 20 years, as in the Financial Assessment Framework method. From the FSP onwards, the method is marked by three characteristics: 1) the UFR, 2) a convergence factor, and 3) a weighted moving average of forward rates.

The manner of extrapolation is characterised by the fact that the extrapolated curve for long maturities automatically converges to the designated long-term level without ever reaching it. As no convergence period is imposed, the UFR does really function as the ultimate rate. The convergence factor determines the speed of convergence after the FSP. This factor determines how quickly interest rates return to their long-term level after a shock. The higher the convergence factor, the more quickly extrapolated forward rates converge to the designated UFR. The convergence factor therefore also influences the volatility of extrapolated forward rates. As the extrapolation method takes account of weighted market data, less interest rate sensitivity occurs around the FSP and market data remain important even beyond the FSP. A second advantage of the extrapolation method is that marked changes in interest rates with long maturities only affect the yield curve if the change proves lasting.

Appendix 7 contains technical information on the implementation of the method.

Other considerations

The Committee also recommends that any future adjustment to this UFR method should come within the remit of the Parameters Committee, which will shortly be set up to advise once every three years on a large number of parameters relevant to pension supervision. In practice, this recommendation does not therefore apply to the first advice to be given by the Parameters Committee on the parameters to apply from 1 January 2015. The UFR Committee has already made provision for this. It would therefore be applicable for the first time for the recommendations on the parameters to apply from 1 January 2018.

The proposed method has a number of characteristics and advantages which the Committee regards as important:

- it is consistent with recent scientific literature;
- it is transparent and easily replicable;
- it is better reasoned than the present method and is consistent with the observations and wishes of market participants and the views of the foreign experts;
- it involves making fewer choices: the level of the UFR is determined by a long-term moving average and it is not necessary to select a point on the curve from which the UFR will have been fully incorporated.

The effect of switching from the present to the proposed UFR method would have only a limited effect on the funding ratio and contributions of an average pension fund and would not therefore have any significant intergenerational effects. This is examined in more detail in Chapter 8.

Chapter 7 explains the choices made by the Committee for each of the three chief characteristics of the method. Section 7.3 deals specifically with the method and contains a qualitative comparison with existing methods of determining the yield curve.

7. Basis for the advice

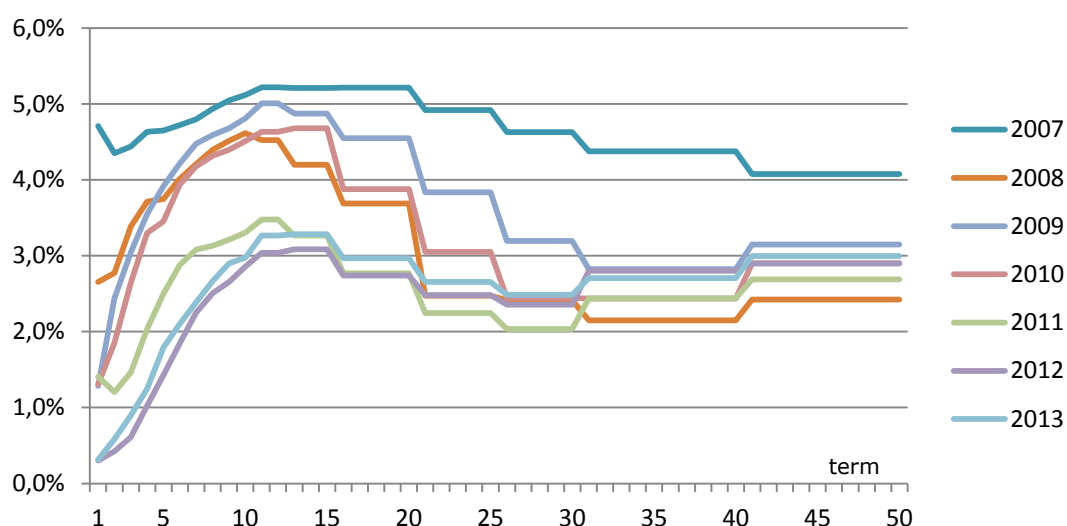
This chapter explains the basis for the Committee's recommendations on three relevant subjects covered in its report: 1) the level of the UFR, 2) the starting point of the method, and 3) the extrapolation method. Section 7.1 discusses a method for determining a suitable level for the UFR. Section 7.2 examines liquidity issues. And, finally, section 7.3 explains why the recommended extrapolation method was chosen.

7.1 Level of the UFR

The Ultimate Forward Rate reflects the value of the forward rate in the very long term. The forward rate is a future short-term interest rate (usually 1 year) whose level is determined in the market now. It is therefore a certain rate: the market participants concerned agree now at what interest rate they will borrow or lend in the future.

The forward rate is therefore determined by the circumstances that currently apply in the financial markets. This rate is therefore volatile, even for periods in the more distant future. The forward rate for the year 2043 fell from 4.9% in 2003 (term of 40 years) to 2.4% in June 2013 (term of 30 years). This fall is comparable to the change in the 1-year rate, which fell from 2.8% to 0.3% over the same period. In other words, short and long-term forward rates move in parallel to a striking degree. Figure 1 shows a selection of forward curves.

Figure 1. Forward rate (per year, at year end and in June 2013).



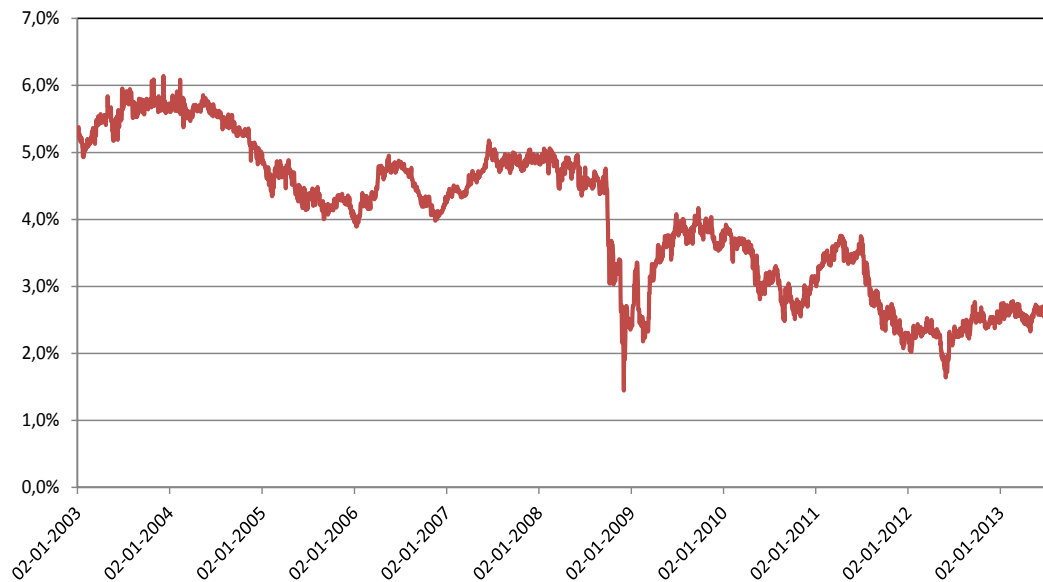
The market is much less liquid in the very long term (over 30 years – see also the findings of the survey among market participants) than in the shorter term. Market data are accordingly less reliable and more sensitive to one-off shocks affecting supply and demand.

7.1.1 Methods of determining the UFR

As no reliable market observations are available for forward rates in the very distant future other methods must be used. Four methods exist:

1. *Extrapolate the yield curve.* It is possible to gauge the UFR by extrapolation of the present yield curve. This has the advantage of making maximum use of market data. The disadvantage is that the result is sensitive to volatility in current market conditions.
2. *Estimate the UFR on the basis of historical forward rates.* A second method is to estimate the UFR on the basis of historical series of forward rates for the longer term, for example the forward rates for 20 or 30 years which yield reliable market data (Figure 2 gives as an example the change in the 20-year forward rate over the period 2003-2013). This method has the advantage that it provides a direct estimate for the UFR and also dampens the sensitivity to market fluctuations. However, it is necessary to decide how the estimate for the UFR should be obtained from the data. For example, how are the data from different years weighted and is allowance made for the trend?

Figure 2. 20-year forward rate over the period 2003-2013



3. *Estimate the UFR on the basis of historical nominal 1-year rates.* Another option is to base the estimate on past realisations of the forward rate. As the forward rate concerns the short-term future interest rate, the obvious course is to take the realisations of the short-term rate as the starting point. A disadvantage of this approach is that this rate is sensitive to past inflation, particularly if it is calculated over a relatively long historical period. A second objection is that this method produces an estimate of the expected interest rate, but not the forward rate. In order to determine this, it is also necessary to assess the premium for interest-rate risk and the convexity adjustment (see Appendix 9).
4. *Estimate the UFR by analysing historical real interest rates.* It is also possible to base the estimate on realised real rates from the past. Here, too, the obvious course is to take the short-term rate as the starting point. The real rate is then determined by correcting the nominal rate for inflation in the relevant period. The period over which inflation is measured must be equal to the maturity of the interest rate. The advantage of this method is that it is less sensitive to past inflation. However, its drawback is that although it may provide an estimate of the expected real interest rate, positions also have to be taken on future inflation, the interest rate risk premium and the convexity adjustment in order to determine the long-term forward rate.

A general problem with historical methods is that the period chosen as the basis for the estimate is a sensitive factor. It is also difficult to take account of underlying changes in the economy, such as ageing, climate change or the extent to which global markets are becoming increasingly financially intertwined.

It may be possible to obtain a more accurate estimate of the UFR by combining different methods. In this way, economic factors such as ageing and the changing financial world can be taken into account in the choice of the UFR, in combination with the historical methods. However, while this would have the advantage of providing a more balanced assessment it would also have the disadvantages of less transparent reasoning and a more unpredictable outcome.

7.1.2 European Commission's reasoning

The European Commission has chosen to use the third method – based on historical real rates – in underpinning the UFR. The chosen value of 4.2% comprises an estimate of 2.2% for the real rates and a 2% inflation rate assumption for the long term. The expected inflation rate has been chosen on the basis of the ECB's target. The real interest rate is based on a study by Dimson et al. (2002) into the returns on government bonds. According to this study, the real return over the period 1900-2009 was 1.7% worldwide. The average in the 12 countries

identified by the authors as important was 2.3% in the second half of the 20th century, compared with -1.1% in the first half. According to Dimson et al., the return on Dutch government bonds was 1.2% in the first half of the 20th century and 1.1% in the second half. The European Commission has explained its choice of a return of 2.2% by reference to the exceptional level of inflation in the first half of the 20th century.

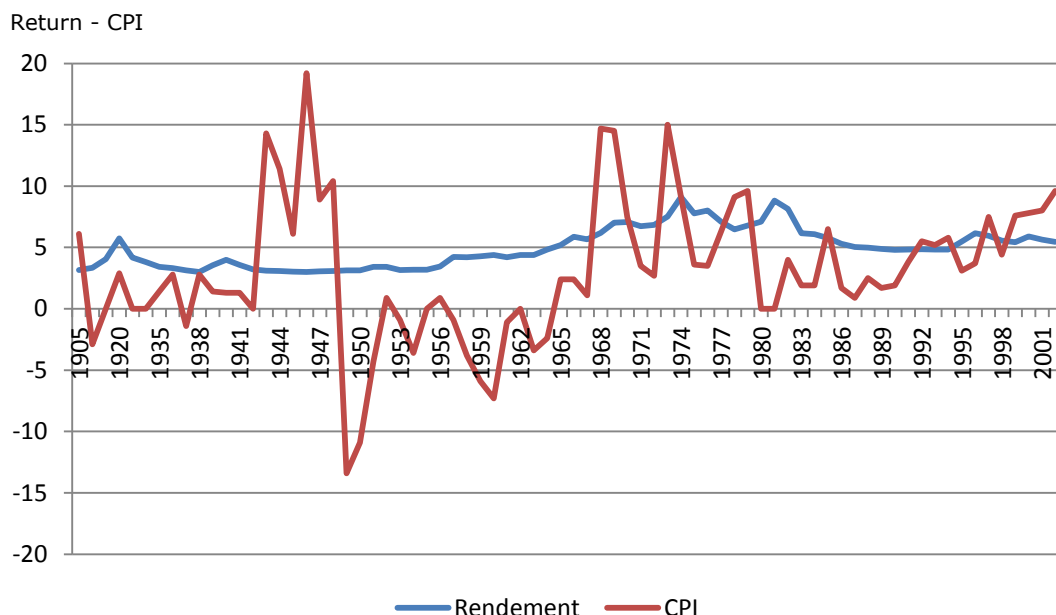
The Committee is far from convinced by the reasons given by the European Commission for its choice of UFR. First, the European Commission disregards the conceptual differences between the expected interest rate and the UFR. Second, its estimate of 2.2% for the real interest rate is high. The European Commission bases this estimate on the high interest rates in the second half of the 20th century. However, this period was exceptional owing to the high rate of post-war growth and the high interest rates needed to curb inflation after the oil crisis. The European Commission's current calculations of long-term economic growth are based on real growth of 1.5% (Working Group on Ageing, 2012) on top of the rate of population growth, which is practically zero. This is less than half of the post-war average of 3.6%, of which 2.5% was attributable to increasing labour productivity and 1% to employment growth. According to the Ramsey rule (Ramsey, 1928), a fall of one percentage point in the growth of labour productivity leads to a corresponding fall of about one percentage point in interest rates.²⁶ Other factors depressing interest rates are the ageing of the population and increased uncertainty. On this basis a real interest rate equal to or lower than the average of 1.7% over the entire century would have been a more logical choice than the rate of 2.2% in the exceptional post-war period.

7.1.3 Uncertainty in the UFR

The UFR is a long-term quantity. It is therefore hard to estimate the UFR on the basis of short-term data. In the long term uncertainties about inflation and real interest rates play a major role. Moreover, the premiums for the inflation risk and interest rate risk are liable to fluctuate. The UFR is therefore not a natural constant which can be determined once and for all. New information about ageing and world economic growth and uncertainties about inflation and interest rates necessitate new estimates of the forward rate in the long term. This uncertainty is reflected in how the UFR has been determined in different parts of the world: whereas the European Union has chosen a value of 4.2%, countries such as Japan and Switzerland have opted for 3.2%. Figure 3 shows very marked variations in the rates of interest and inflation in the Netherlands over time, and that there may be long periods of either high or low real interest rates.

²⁶ The Ramsey rule assumes a link between the return on savings and economic growth. High economic growth is accompanied by great investment demand, which pushes up interest rates.

Figure 3. Return (in %, vertical axis) on perpetual government bonds and consumer price inflation in the Netherlands



7.1.4 UFR Committee's recommendation

In view of the large variation in the rates of interest and inflation, it would make sense for the UFR to be coupled to direct information about long-term forward rates. Fixing the UFR as a natural constant for a long period is not logical. The influence of one-off factors could be reduced by taking account of changes in the long-term (20-year) forward rates over the past 10 years when setting the UFR. In practice, the Committee recommends that the UFR be determined at any given moment as the average of the realised 20-year forward rates in the previous 120 months (end-of-month positions). The advantage of determining the UFR in this way would be to dampen volatility and make the UFR highly predictable. The link with realised rates in the past would be transparent to market participants and prevent distortions caused by discretionary decisions on adjustments to the UFR. On the basis of the realised 20-year forward rates in the past 10 years, the UFR, when calculated in accordance with this method, would be 3.9% (rounded) at 31 July 2013. This value could be adjusted monthly in line with the moving average over the previous 120 months.

Needless to say, the choice of an averaging term of 10 years is somewhat arbitrary. Nonetheless, the Committee expects this term to inject stability while at the same time taking account of underlying changes in the economy. An unduly short averaging period would be at the expense of stability and an unduly long averaging period would pay too little heed to current developments.

The rate recommended by the Committee is slightly lower than the European Commission's figure of 4.2%. The Committee considers that this is reasonable in the light of economic developments. As noted above, the European Commission has based its UFR on the average long-term real interest rate of 2.2% in the second half of the 20th century. However, this period was characterised by an exceptionally high average rate of economic growth. The 1.7% average real interest rate for the century as a whole therefore seems to provide a more realistic starting point. In addition, the ageing of the population and lower growth rates in the future are grounds for assuming a lower rate of interest in the long term.

7.2 Last Liquid Point (LLP)

This section deals in brief with the concept of liquidity and the reliability of market data. The Committee has taken into account in its advice the findings of the survey conducted among market participants.

7.2.1 Liquidity in the swap market

An interest rate swap is a financial transaction in which the parties exchange interest payments over a given term or part of a term. Pension funds and insurers operate in the swap market mainly in order to be sure of receiving a fixed interest rate. However, other market participants such as banks, businesses and dealers enter the market precisely in order to receive a variable interest rate. The expectations and risk aversion of all these market participants decide the price of the transaction, as do actual supply and demand and their relationship with the price formation process in the risk-free bond market.

Liquidity is a concept which reflects the ratio of demand to supply. Three dimensions can be identified here:

1. the transaction volume that can be traded without distorting the price;
2. the ratio of buyers to sellers;
3. the market impact, defined as the time which market prices need in order to return to their original level after large transactions.

The starting point of the present UFR extrapolation is the LLP. Determining the LLP objectively is no simple matter. For example, data about transaction volumes are not available from the usual sources for financial data because trading often takes place over the counter, i.e. directly between parties rather than on an exchange. Moreover, liquidity is dependent on market conditions. Liquidity is not a static given: it declines over time. As liquidity declines, so does the reliability of the observed market data.

7.2.2 UFR Committee's recommendation

In view of the above analysis and the findings of the survey conducted among the market participants, the Committee considers that it would be wrong to designate a single point as the LLP. There seems to be little evidence for the existence of a single point after which liquidity dries up. The choice of a single LLP is too rigid and fails to take account of all available market data.

On the basis of the survey among market participants, the Committee notes that liquidity diminishes faster after the 30-year point than before this point. The great majority of the respondents therefore set the LLP at 30 years. At the same time, they state that there is not much difference between liquidity at 20 and 30 years. The Committee therefore recommends that 20 years be taken as the starting point for this method since it is virtually undisputed that the market up to this point has good liquidity and that even beyond this point the market should not be completely disregarded. The Committee also recommends that in determining the interest rate levels applicable to maturities of more than 20 years all available market data should serve as input, while recognising that their importance diminishes the further away the maturities are. As argued previously in this report, it is therefore more correct to speak of a First Smoothing Point (FSP) than a Last Liquid Point (LLP). The LLP then indicates up to what maturity market data should be used as input beyond the FSP. The extrapolation method recommended by the Committee therefore continues to make use of market data for a long period, to be weighted with parameters (see also section 7.3 on the yield curve). An advantage of the UFR Committee's method is that the interest rate sensitivity which concentrates around the chosen LLP is spread over a longer period.

7.3 Extrapolation method

This section describes the criteria underlying the method proposed by this Committee and describes the features of this method. Appendix 8 contains the technical specifications for modelling the yield curve.

7.3.1 General criteria

An yield curve describes the level of the interest rate for different maturities at any given time. A method for determining the yield curve should be based on observed interest rates on maturities for which there is a sufficiently liquid market. In the case of longer maturities, the method will involve making an assessment based as far as possible on the observed data.²⁷ A collection of interest rates with different maturities is used as input. Additional assumptions are made for extrapolation in the case of maturities beyond the FSP, generally with regard to

²⁷ Or on observed prices of instruments directly driven by the intended interest rate.

the behaviour of forward rates. Both types of rates are closely interconnected, as indicated above. Sections 7.3.2 to 7.3.5 describe various methods which can be used to determine the yield curve.

7.3.2 Alternative methods

The following sections describe three extrapolation methods which have been or could be used to determine the nominal yield curve for use by pension funds: 1) the method applied by DNB until September 2012 (Financial Assessment Framework), 2) the method introduced in September 2012 (DNB's UFR method), and 3) the Smith-Wilson method proposed in the context of Solvency II.²⁸

A summary of the similarities and differences between the methods can be found in Table 2 below.

Table 2. Comparison of existing methods and the UFR Committee's proposal

	FSP	LLP	Convergence path	UFR
Financial Assessment Framework	-	50	-	equal to the last observed forward rate
Smith-Wilson method	-	20	60	4.2%
DNB's UFR method	20	50	60	4.2%
UFR Committee's proposal	20	50	infinity	moving average forward rate

NB: the difference between an FSP and LLP is defined as follows for our purposes: after the LLP there is no further market data input whereas after the FSP there is still some input of market data; all market data serve as input before the FSP.

7.3.3 Alternative methods: Financial Assessment Framework method

The nominal zero coupon yield curve in the context of the Financial Assessment Framework is based on the swap curve for maturities of 1 to 10, 12, 15, 20, 25, 30, 40 and 50 years. For these maturities the zero coupon rates are derived from swap rates. Maturity points that are not available are estimated by assuming that intermediate forward rates are constant. This principle is also applied in the extrapolation. Longer dated forward rates are set equal to the

²⁸ Insurers in the Netherlands can also make use of the ECB AAA curve. As this curve has, formally speaking, only a maximum maturity of 30 years, it has not been included in the comparison.

most recently observed 49-year forward rate. The UFR is therefore equal to the most recently observed forward rate.

7.3.4 Alternative methods: Smith-Wilson method

The Smith-Wilson method presupposes a functional form for the price of a zero coupon bond for each maturity, based on a parametric model. This method is characterised by the fact that all functional forms are driven by one and the same function, namely the Wilson function. This function is hard to interpret in economic terms and appears in this respect to diverge from the academic literature on yield curve models. The function is characterised by a convergence parameter and a level parameter, specifically the Ultimate Forward Rate (UFR). The UFR should be determined outside the model on the basis of expert opinion. Convergence to the UFR takes place from the last market price considered reliable, namely the LLP. The convergence criterion is that, starting from a chosen maturity, the extrapolated interest rate must be closely aligned with the UFR. A UFR of 4.2% is proposed in the case of the euro area, as a result of which interest rates will converge in the long term to 4.2%. Under the Smith-Wilson method, therefore, extrapolated rates are determined by the LLP, the UFR and the convergence speed. Since the introduction of the method much attention has been focused in academic and policy-making circles on the determination of each of these parameters.

7.3.5 Alternative methods: DNB's UFR method

In DNB's UFR method, the nominal zero coupon yield curve is a combination of the Financial Assessment Framework method and the Smith-Wilson method. This method was introduced by DNB as part of the September Pension Package on 30 September 2012. The method provides for an FSP of 20 years. Until the FSP is reached, interest rates are determined in accordance with the Financial Assessment Framework method, although this is done on the basis of 3-month averages rather than daily rates.²⁹ From the FSP onwards, forward rates are extrapolated to a convergence period of 60 years. Extrapolation involves weighting post-FSP market forward rates with a UFR of 4.20%.³⁰ The weights are based on application of the Smith-Wilson method derived from the values of the FSP, the UFR and the convergence period as mentioned above. From a maturity of 60 years the forward rate is fixed at 4.20%, with the result that the rates converge to 4.20% in the long term.

²⁹ In January 2012 DNB decided, in the light of the market fluctuations during the financial crisis and the European debt crisis, to adopt 3-month averaging of the yield curve from end-2011. This anticipated the introduction of funding ratio averaging as envisaged under the new Financial Assessments Framework. When the new Financial Assessment Framework takes effect, the 3-month averaging will in any event cease to apply.

³⁰ These market forward rates are determined in accordance with the Financial Assessment Framework model.

DNB has chosen this method because the Smith-Wilson method creates an unduly large degree of interest rate sensitivity around the LLP, which would lead to extreme positions and necessitate many transactions for pension funds that wish to hedge their interest rate risk accurately, with all the consequences that this would entail for prices on the financial markets.³¹

7.3.6 UFR Committee's recommendation

The yield curve proposed by the Committee is a combination of the method used by DNB from the introduction of the Financial Assessment Framework until September 2012 and a new extrapolation method. The manner of extrapolation presupposes a first smoothing point and the constancy of long-term rates. This method is in keeping with the UFR method introduced by DNB in September 2012. A new feature is that divergences in observed rates in the case of long maturities are spread over time before being used as input. An assumption is no longer needed for a maturity from which the forward rates are virtually the same as the UFR.

In the proposed method extrapolation takes place at the level of forward rates, where the manner of extrapolation is based on the assumption of a one-factor interest rate model for long maturities.³² A factor-based interest rate model is used in an attempt to determine those elements that explain the dynamics of the interest rate. The extrapolation is characterised by:

- a specific starting point (i.e. the FSP);
- a fixed long-term level of the forward rate (UFR) and hence of the interest rate itself;
- a convergence factor;
- a Last Liquid Forward Rate (LLFR), which is a moving weighted average of post-FSP forward rates.

The manner of extrapolation is characterised by the fact that the extrapolated curve for long maturities converges automatically to the designated long-term level (the UFR) without ever reaching it. As no convergence period is imposed, the UFR truly functions as the ultimate rate. The observed market data on post-FSP maturities are not ignored, but play a role in the extrapolation of the curve. This also ensures that pension funds' hedging strategies do not become overly sensitive to interest rates in the 20-year FSP. The convergence factor determines the speed of post-FSP convergence to the UFR. The greater the convergence factor, the faster the extrapolated forward rates will converge to the designated UFR. The convergence factor therefore also influences the volatility of extrapolated forward rates.

³¹ See DNB's publication on the introduction of the method (<http://www.toezicht.dnb.nl/5/18/50-226790.jsp>) and the criticism by Kocken et al. of rate risk hedging (2012).

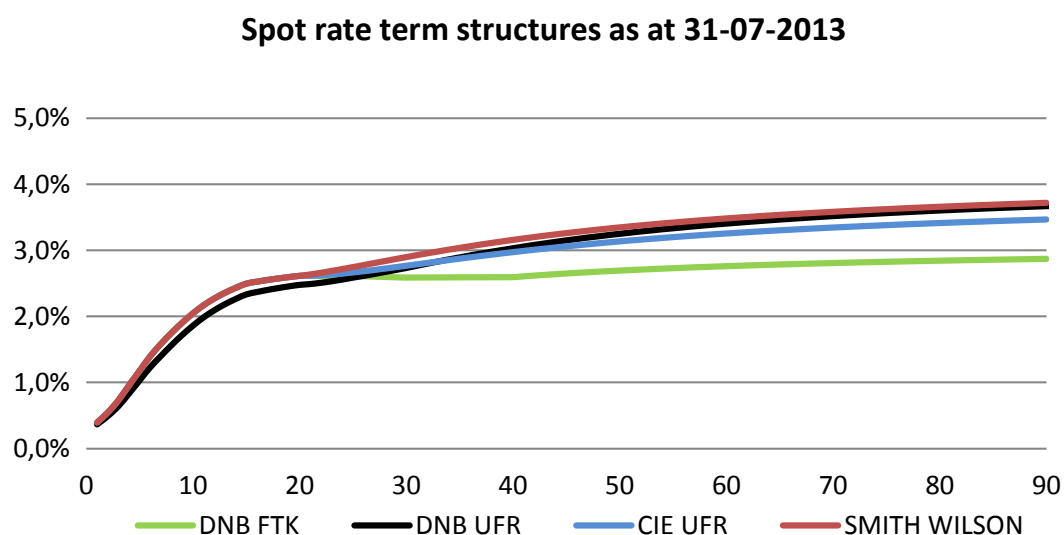
³² Models in which all interest rates with a different maturity are based on the short-term rate are called one-factor models. In general, it is assumed that the long end of the forward curve is influenced by only one factor.

The function of the LLFR mechanism is twofold:

1. The use of post-FSP market data in this way reduces interest rate sensitivity around the FSP.³³
2. Interest rates that occasionally change sharply and have long maturities (beyond the FSP) serve as input only partially. Only after such a change proves to be permanent does it affect the course of the curve.

Figures 4 and 5 show the course of the spot and forward rate term structures in the Committee's proposal, compared with a few alternative methods.

Figure 4. Spot rate term structures

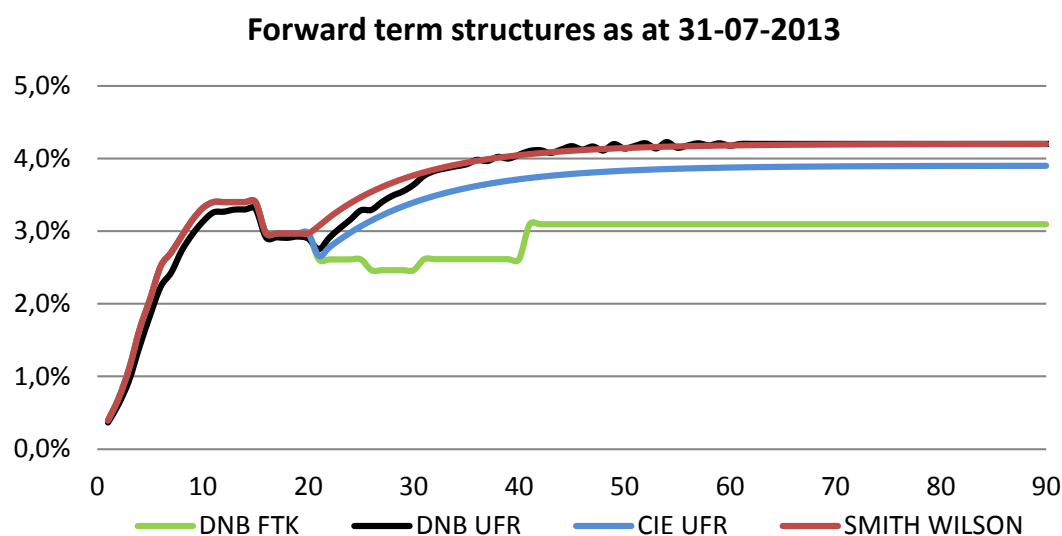


Yield curves as at 31/7/2013

In Figure 4 the yield curves under the Financial Assessment Framework, UFR Committee and Smith-Wilson methods coincide up to the 20-year maturity point. DNB's UFR method diverges from them as a consequence of the 3-month averaging. After the 20-year maturity the effect of the different extrapolation methods becomes clear.

³³ This is analogous to the input of observed market data with a diminishing weight for maturities of 25 and 30 years in the Financial Assessment Framework method.

Figure 5. Forward rate term structures



Forward rate term structures as at 31/7/2013

In Figure 5, as in Figure 4, we can see that the forward rate term structures under the Financial Assessment Framework, UFR Committee and Smith-Wilson methods coincide up to the 20-year maturity point. Here, too, DNB's UFR method diverges as a consequence of the 3-month averaging. After the 20-year maturity the effect of the different extrapolation methods become apparent. The erratic course of DNB's UFR method is a consequence of using fixed weights.

The main parameters in the UFR Committee's method are the level of the UFR, the convergence factor and the post-FSP weighting factors. The reasons for the level of the UFR have been explained in section 7.1 above. The reasoning behind the other parameters is given below.

7.3.7 Reasoning behind parameter values: convergence factor

The convergence factor plays a role in the extrapolation of post-FSP forward rates. The present UFR method amounts to a convergence factor of almost 20%.³⁴ No unequivocal evidence can be found in economic empirical literature for a given value of the convergence factor. The existence of a convergence factor greater than zero is often called into doubt,

³⁴ This 20% is based on comparison of the level of the technical provisions of the present UFR method with the level in the method proposed by the UFR Committee. If a convergence factor of 20% is applied in the latter method, this would give approximately the same outcome as in the case of the present UFR method. And if a convergence factor of 30% is applied, this would give approximately the same outcome as in the case of the Smith-Wilson method.

although some evidence can be found for a convergence factor that does not exceed 5%.³⁵ The Committee considers that it would be sensible to take a big step towards a more market-consistent parameter based on empirical literature. This would be consistent with the criterion formulated in Chapter 5 that there should be maximum input from market data in determining the UFR method. At the same time, taking a big step away from the convergence factor currently used would result in a significant increase in the technical provisions of pension funds and could have a major market impact, which the Committee does not consider desirable. The lower convergence factor is mainly found on the basis of long historical series. However, these are mainly driven by the inflation process and not by real interest rates. The introduction of monetary union in Europe has introduced a new inflation regime. As a result, a higher convergence factor seems more plausible. The Committee therefore recommends using a convergence factor of 10%. It regards this 10% as a major first step towards a more market-consistent parameter, but considers it prudent not to make the initial step too big. Unfortunately, literature on the correct convergence factor is scarce. The Committee therefore recommends that in due course the Parameters Committee carry out a further study to determine an acceptable convergence factor.

7.3.8 Reasoning behind parameter values: weighting factors

Extrapolating the post-FSP yield curve involves estimating a Last Liquid Forward Rate (LLFR). The LLFR is a weighted average of the previous day's LLFR and a weighted average of post-FSP forward rates.

Let us start with the last factor. The post-FSP forward rates (until a maturity equal to the LLP, i.e. 50 years) serve as input so that the available market data on these points can also be used. These forward rates are then weighted in order to express the reduced liquidity of these points. The Committee recommends recursive weighting and that the weighting factors 8/15, 4/15, 2/15 and 1/15 be used for maturities of 25, 30, 40 and 50 years respectively.

Use of the previous day's LLFR for weighting purposes helps to ensure that temporary outliers in the weighted forward rates do not immediately result in large adjustments to the curve. Only when there is a structural divergence in the weighted forward rates does the curve adjust to take account of this. This weighting factor therefore decides how much weight is given to new market data in comparison with the previous observation. The Committee has used a weighting factor of 50% for this previous observation. This implies a weighting factor of 50% for new information.

The weighting factors are decisive, particularly for the interest rate sensitivity of the method in the period around and after the FSP. For example, a higher weighting factor for the first post-

³⁵ See the articles of Babbs and Nowman (1999), Van den End (2013) and De Jong (2000).

FSP forward rate would result in a decline in the interest rate sensitivity at the long end of the curve. A low value would cause interest rate sensitivity comparable to that under the Smith-Wilson method.

The recursive weighting in the LLFR helps to lessen the volatility of the yield curve. This helps to deal with the limited liquidity of the market as a whole in relation to the total interest rate exposure of the pension sector.

8. Impact analysis and assessment of basic criteria

8.1 Impact on pension funds and intergenerational effects

The Committee's advice has a limited impact on funding ratios, contributions and intergenerational redistribution. Following the Committee's advice would (based on calculations as at 31 July 2013) mean a 1.1% fall in technical provisions (and hence a rise in the funding ratio) compared with the current UFR method based on the 3-month average interest rate. In the case of cost-effective contributions, the introduction of the proposed UFR method means a fall of 0.3% (i.e. a fund that has a cost-effective contribution of 20% will see this fall to 19.9%).

Table 3. Impact analysis as at 31 July 2013

Method	UFR	FSP	LLP	Convergence path	Technical provisions	Contributions
Financial Assessment Framework	3.09%	-	50	-	101.6%	+5.9%
DNB's UFR method	4.2%	20	50	60 years	98.0%	-2.1%
DNB's UFR (3-m avg.) method ¹	4.2%	20	50	60 years	100.0%	0.0%
Smith-Wilson	4.2%	-	20	60 years	97.4%	-3.4%
UFR Committee	3.9%	20	50	infinity	98.9%	-0.3%

¹ DNB's UFR (3-m avg.) method is DNB's UFR extrapolation method based on three-month averaging. This is the current UFR method.

Table 3 shows the impact of the different methods on the level of the technical provisions and contributions and makes a comparison with DNB's existing UFR method based on three-month averaging. DNB's UFR method is characterised by an FSP of 20 years and an LLP of 50 years based on a UFR of 4.2%, with a convergence path of 60 years. The simultaneous use of an FSP and LLP indicates that market data are taken into account up to the LLP, although this is done to a lesser extent after the FSP owing to the lower levels of liquidity after this point. Under the Smith-Wilson method, no market data are taken into account for maturities of 20 years or more, which means that this method has an LLP of 20 years and no FSP. It is also possible to specify a UFR for the Financial Assessment Framework method, i.e. the last observed forward rate based on an LLP of 50 years. As a result, this method does not incorporate a convergence path (in contrast to the other methods) or an FSP.

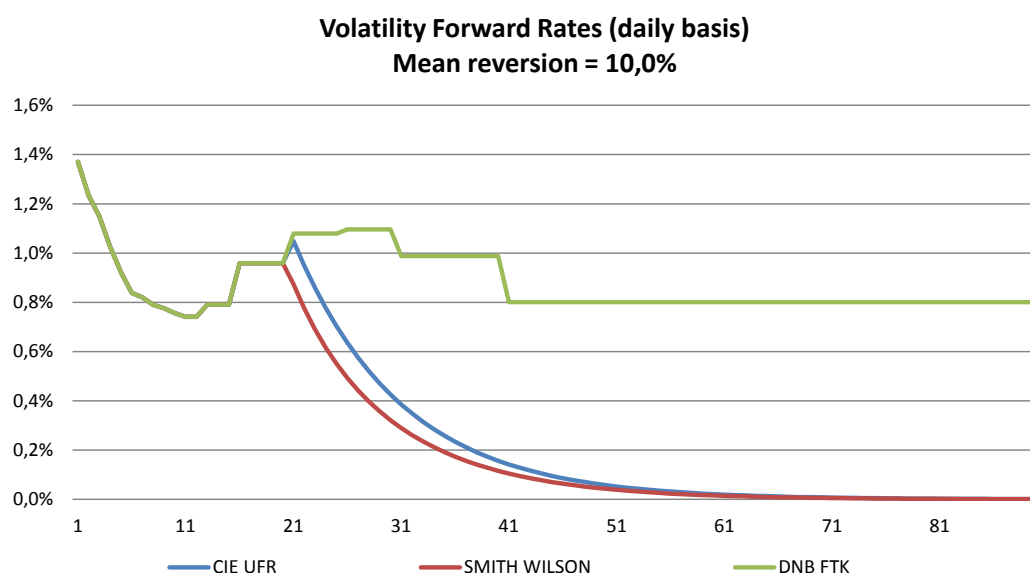
The UFR Committee's method has the effect of slightly reducing technical provisions and increasing contributions compared with the method currently in force, i.e. DNB's UFR method

based on three-month averaging (figures as at 31 July 2012).³⁶ The fall in technical provisions amounts to approximately 1.1%. Without three-month averaging, under DNB's UFR method the technical provisions would be around 2 percentage points lower. The UFR Committee's method does not have a three-month average although it does have a slightly lower UFR than both of DNB's methods. On balance, the impact on technical provisions as at 31 July 2013 lies in-between the results for DNB's UFR methods. There is slightly less of an impact on contributions owing to the longer duration of the contribution cash flows and a lower UFR.

As the impact of the UFR method proposed by the Committee differs only slightly from that of the current UFR method, the Committee has not calculated the intergenerational effects. These effects are also expected to be small compared with the current UFR method.

The advantage of the recommended method over the current method is that interest rate volatility declines after the FSP. Volatility is spread over a longer period. Figures 6 and 7 show the volatility of the forward rate and the spot rate for different methods. There is a slight increase in the interest rate sensitivity of the technical provisions compared with the current method, although this increase is acceptable. Figure 8 shows the interest rate sensitivity of technical provisions.

Figure 6. Volatility of forward rate (daily)



³⁶ Technical provisions and contributions based on the cash flows for 2012 as reported by the sector. The associated durations are 18.2 years (technical provisions) and 25.9 years (contributions). The impact on technical provisions will be slightly greater than this for funds that are younger than the sector average and slightly less for older funds.

Figure 7. Volatility of spot rate (daily)

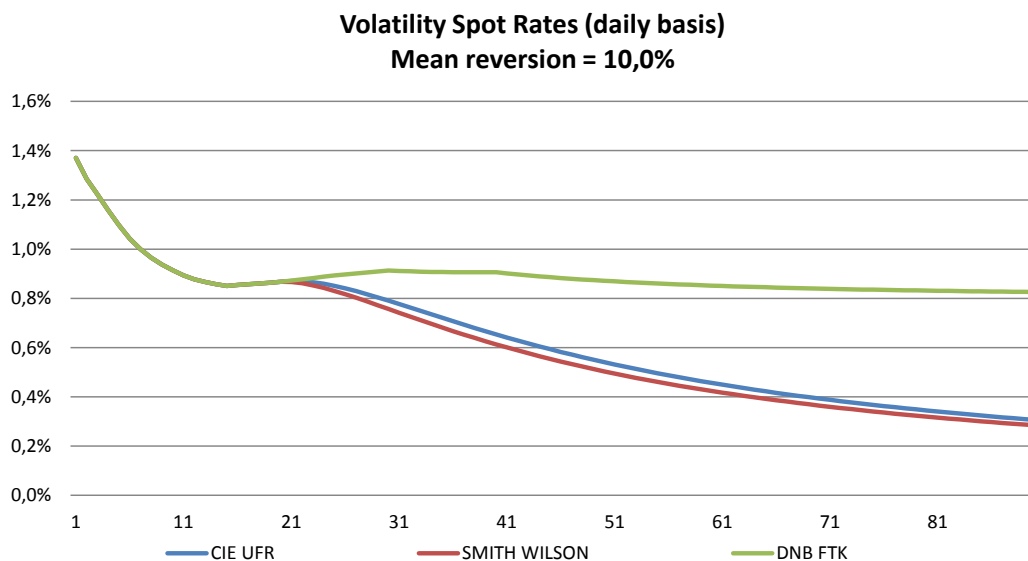
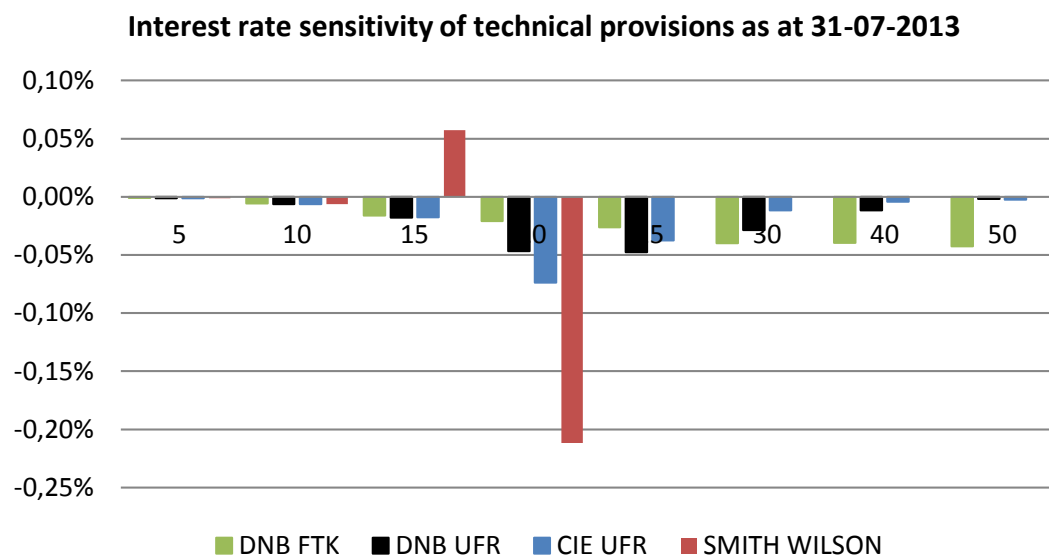


Figure 8. Interest rate sensitivity of technical provisions as at 31 July 2013



Interest rate sensitivity of technical provisions as at 31 July 2013

NB: the interest rate sensitivity of technical provisions is determined in terms of basis points (as a percentage of the technical provisions) at the level of the underlying swap rates. The horizontal axis shows baskets of maturities: '5' represents maturities of up to 5 years, '10' represents maturities of 6-10 years, etc.

8.2 Assessment of basic criteria

A number of basic criteria that should be met by a chosen UFR method have been formulated in Chapter 5. In this section, these basic criteria are used to assess the method proposed by the Committee. In this context, reference is also made to various existing methods as described in Chapter 7.

8.2.1 Consistency with financial markets

All of the methods that were discussed showed full consistency with financial markets up to the last liquid point. In addition, the Financial Assessment Framework method is also consistent with observed post-FSP market rates. The other methods show less consistency with post-FSP market rates, with the greatest differences being found using the parameters in the Smith-Wilson method. If the level of the forward rate around the FSP differs from the UFR to a certain extent, this, in combination with a short convergence period, will mean the course of the long end of the Smith-Wilson yield curve is not constant.

The UFR Committee's method, just as DNB's UFR method, is based in part on market data for maturities beyond the FSP. Not imposing a convergence period means the course of the curve is more smooth, making the UFR a genuine ultimate rate.

8.2.2 Transparent and replicable

All the methods are fully transparent and easy to replicate. Larger pension funds determine the yield curve on a daily basis using the Financial Assessment Framework method and DNB's UFR method.

With regard to the Smith-Wilson method, there is no economic interpretation of the Wilson function, which makes it difficult to substantiate an economically meaningful extrapolation. The method should be viewed primarily as a mathematical construct. The value of the convergence factor is, however, crucial for the curve after the FSP. The selection and underpinning of the parameters need to be based on expert opinion. The same also applies to the determination of the FSP and the UFR in the case of DNB's UFR method, and to the determination of the parameter values in the UFR Committee's method.

8.2.3 Consistency with academic literature

The underpinning of the level of the UFR in the Smith-Wilson method is generally considered to be weak. The value is based on an expert opinion, which in turn is based on an analysis of long-term average rates of inflation and real rates. The length and relevance of the periods for which these averages are determined are not substantiated. Moreover, the averages are not

weighted (all information is of equal importance) and no consideration is given to the uncertainty of the estimate.

Criticism of DNB's UFR method mainly concerns the underpinning of the level of the UFR as part of the Smith-Wilson method and the selection of fixed weights as at 30 September 2012, which are felt to be arbitrary.

The UFR Committee's method is closely connected to the estimating process used in affine term structure models. Such models have a flexible structure that is particularly well suited to modelling interest rate dynamics. Models of this kind have been used to study yield curves since the 1980s.

8.2.4 No distortion of financial markets

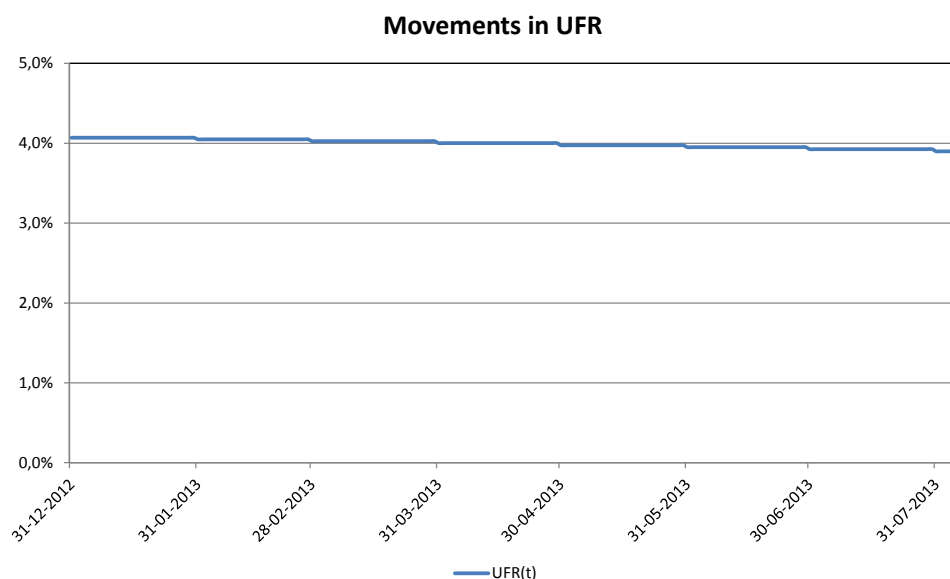
When the Financial Assessment Framework method was used, insofar as we are aware no perverse incentives for financial markets were discovered. With regard to the Smith-Wilson method, the last forward rate around the FSP determines the course of the extrapolation and hence interest rate sensitivity around the FSP. If the selected FSP is too low, this can easily lead to market distortions around the FSP. Owing to the criticism of the high level of interest rate sensitivity around the LLP in the Smith-Wilson method, DNB developed an alternative manner of extrapolation for DNB's UFR method. By giving some consideration to post-FSP forward rates, based on fixed weightings, it is possible to reduce the risk of market distortion around the FSP and increase the hedgeability of long-term interest rates in practical terms.

In view of the above, the Committee paid close attention to any market distortion the method might cause, and attempted to minimise it, when selecting the parameter values. Reference is made to the impact analysis for details of the estimated impact.

8.2.5 Stability

Insofar as we are aware, the Financial Assessment Framework method has not caused any market distortion. The method came under pressure due to the credit crunch. The introduction of DNB's UFR method appears to have reduced demand for long-term hedging products, as a result of which long-term interest rates have risen. This seems to have lessened the likelihood of low long-term interest rates. In this context, the Committee expects that the UFR method it is proposing will have little, if any, additional impact. In Figure 9, we can see that when a 120-month average is used to determine the UFR, the resulting trend is stable and predictable.

Figure 9. UFR based on 120-month averaging.



8.2.6 *Internationally sustainable*

The UFR method proposed by the Committee differs from the method envisaged in the context of Solvency II. The Committee believes this is justifiable, as explained in Chapter 3. Should a European framework for pension funds be established that is relevant for Dutch pension funds, this can, in due course, be taken into consideration by the Committee when revising the UFR method. Developments in Europe have shown that with regard to the UFR method countries are opting for different solutions, which depend on specific national and other circumstances. The Netherlands is no exception in this respect. Finally, market participants and experts, particularly in the Netherlands, have criticised the Smith-Wilson method proposed in the context of Solvency II. Good practices in the Netherlands and other countries could prove valuable for the discussion concerning the details of the UFR method within Europe.

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Appendix 2. Glossary

Convexity adjustment: in a financial context, an adjustment (correction) is made for convexity since the increase in the price of a bond when interest rates fall is greater than the decline in the bond price when interest rates rise.

Funding ratio: the funding ratio is an indicator of a pension fund's financial position. It is the ratio of the value of a pension fund's invested assets to the value of its liabilities. The funding ratio therefore indicates whether a pension fund is expected to be able to meet its nominal commitments. If the funding ratio is exactly 100%, there is, in principle, precisely enough money to be able to fulfil all of the accrued unconditional pension commitments.

Discount curve: the discount curve shows how future cash flows need to be discounted for different maturities in order to calculate the value of the liabilities

EIOPA: the European Insurance and Occupational Pensions Authority is the European supervisory authority for insurers and pension funds and the successor to CEIOPS. EIOPA has the task of promoting the improvement and harmonisation of rules, standards and practices in the area of supervision at a European level. EIOPA is involved in the establishment of IORP II, the new European prudential supervision framework for pension funds.

Financial Assessment Framework: the Financial Assessment Framework (*Financieel Toetsingskader* or FTK) is the part of the Pensions Act (*Pensioenwet*) that contains the statutory provisions on the funding of pension funds. The aim of the Financial Assessment Framework (FTK) is to protect pension commitments for members of pension funds.

Forward rate: the forward rate is the rate of interest applying to a financial transaction that will take place in the future but the price of which is fixed immediately.

Hedging: covering risks by entering into another transaction.

Indexation: the upward adjustment of pension entitlements to compensate for past inflation.

IORP: an IORP is an institution for occupational retirement provisions. The IORP Directive is a regulatory framework for occupational pension funds in Europe. The aims of the directive include promoting cross-border activity and promoting secure and efficient investment. As the European Commission considers that the directive does not work well, steps have been made

to come to a revision. The revision is the subject of an impact study (Quantitative Impact Study, QIS), and the initial findings relating to Dutch pension funds were published in May.

Last liquid point: the last liquid point (LLP) is the theoretical longest maturity (point) in the yield curve that is still considered sufficiently liquid. Maturities that are longer are assumed not to be as liquid.

Long-Term Guarantee Assessment: the Long-Term Guarantee Assessment (LTGA) examines the impact of Solvency II on long-term products. The LTGA focuses primarily on the quantitative impact of potential changes to the rate term structure.

Market-consistent: a market-consistent valuation is a valuation based on products and prices that are observable in the market (the replicating portfolio theory) to the extent that these products and prices are created in a sufficiently liquid market. If there is insufficient liquidity and/or the products and prices are not sufficiently observable, it is necessary to use generally accepted additional assumptions that help to approximate the market-consistent value as closely as possible.

Mean reversion: mean reversion is the tendency of interest rates to fluctuate around a historical average. When interest rates differ from this average, macroeconomic forces work to bring them back to the historical average. The extent of mean reversion is indicated by a convergence factor.

Over-the-counter: some traders and organisations prefer to enter into transactions without the involvement of a market. Such transactions are known as over-the-counter transactions. The decision to execute OTC transactions may be made to save time or costs, or because the OTC market offers greater scope for customisation.

Pensions Act: the Pensions Act (*Pensioenwet*), which entered into force on 1 January 2007, describes the duties and responsibilities that employers, employees and pension providers have in the area of pensions. The principle of the market valuation of liabilities is enshrined in the Pensions Act.

Actuarial rate: the actuarial rate is a rate, derived from the interest rate market, that is used by pension funds to calculate the current value of future payments. The actuarial rate is not so much an interest rate as an yield curve.

Interest rate risk: the risk that the value of assets and liabilities may change due to changes in interest rates, as a result of which the funding ratio may change

Yield curve: the yield curve (also known as the yield curve) represents the relationship between the maturity of a financial product and the market rate of interest to be received for that product.

Risk-free interest rate: the risk-free interest rate (or risk-free rate) is the theoretical return on a risk-free investment. No investment is entirely free of risk, but as a general rule the yield on long-term government bonds is used as an approximation of the risk-free interest rate.

Smith-Wilson method: in 2001, Andrew Smith and Tim Wilson published a method for extrapolating the yield curve beyond the last liquid point. The application of the Smith-Wilson method is being proposed by EIOPA in the context of the Solvency II supervision framework.

Solvency II: Solvency II, which was published in 2009, is the supervision framework for insurers. The related technical rules are currently being worked out. Under existing proposals, the UFR has been fixed at 4.2%. Once it has been ratified, the Solvency II directive will apply to European insurers and it will determine, among other things, the capital requirements that insurers have to meet.

Spot rate: the spot rate, unlike the forward rate, is the current price for a product that is traded immediately.

Spread (bid-offer spread): the difference between the bid price and the offer price quoted for a financial instrument. The bid price is the price that the buyer wants to pay for a product. The offer price is the price at which the seller wishes to sell that product.

Swap: a swap is a financial product in which the parties transfer a risk by exchanging the cash flows related to that risk (e.g. interest swap: transfer of interest rate risk; credit default swap: transfer of credit risk). Swaps are frequently used to hedge exposures.

Ultimate Forward Rate: the UFR is the one-year forward rate for the very long term. This rate can be considered the level towards which interest rates for very long maturities converge.

Zero coupon rate: a zero coupon bond provides one cash flow when it matures. This cash flow comprises the redemption and a return, known as the zero coupon rate. Thanks to this feature, it is possible to replicate pension liability cash flows using a basket of zero coupon bonds. Where this is done, the principle of market-consistent valuation requires that the value of the pension liability is equal to the value of the basket of zero coupon bonds, or that the cash flows are valued using the zero coupon rates (spot rates) corresponding to the relevant cash-flow maturities.

Appendix 3. Committee's remit

Decree of the State Secretary for Social Affairs and Employment
dated 21 December 2012

The State Secretary for Social Affairs and Employment,

Having regard to section 2 of the Advisory Boards and Committees (Remuneration) Act (*Wet vergoedingen adviescolleges en commissies*);

Has decreed as follows:

Article 1 Definitions

For the purpose of this decree, the following definitions apply.

committee: the UFR Committee, as referred to in article 2, paragraph 1;

ministry: the Ministry of Social Affairs and Employment.

Article 2 Establishment

There is to be a UFR Committee.

The committee is to be established for a period ending on 30 June 2013.

Article 3 Tasks

The committee is to have the following task:

- a. to consider whether and, if so, to what extent the Ultimate Forward Rate (UFR) method, to be applied to the yield curve for pension funds with effect from 30 September 2012, ought to be adjusted in connection with the method's structural application after 2013, when the basic criteria are that the UFR forms the best possible approximation of the risk-free interest rate which can be expected in the long term, and that the application of the UFR enables the yield curve as a whole to form the best possible approximation of the risk-free interest rate;
- b. to come up with recommendations, based on the findings obtained when performing the task referred to in point a), regarding a method that can be used for determining whether the UFR and its application are, and will continue to be, realistic;
- c. to take the similar method that is expected to be developed by the European Insurance and Occupational Pension Authority (EIOPA) into consideration when making the recommendations referred to in b), to which end the committee, in addition to

having contact with EIOPA, may also consult other experts in the Netherlands and other countries.

The remit referred to in the first part of this article may be adjusted if decisions taken in connection with the Solvency II directive give grounds to do so.

Article 4 Composition

The committee is to consist of the following members:

T.W. Langejan (chair)
Professor C. van Ewijk
Professor T.E. Nijman
Professor A.A.J. Pelsser
Professor O.C.H.M. Sleijpen
Professor O.W. Steenbeek

Article 5 Administrative office

The ministry is to make arrangements for an administrative office.

Article 6 Remuneration

The members are to be granted remuneration for each meeting in accordance with the rules set out in the Advisory Boards and Committees (Remuneration) Act or the (Advisory Boards and Committees (Remuneration) Decree (*Besluit vergoedingen adviescolleges en commissies*)). The remuneration granted for each meeting amounts to 3% of the maximum for salary scale 18 as contained in appendix B of the Civil Servants' Pay Decree 1984 (*Bezoldigingsbesluit Burgerlijke Rijksambtenaren 1984*).

Article 7 Entry into force

This decree shall enter into force on the day after the date of the Government Gazette in which it is published.

This decree shall cease to have effect on 1 July 2013.

Article 8 Short title

This decree is to be cited as: the Decree establishing the UFR Committee.

This decree, together with the explanatory notes, is to be published in the Government Gazette.

The Hague, 21 December 2012
the State Secretary for Social Affairs and Employment,

J. Klijnsma

Explanatory notes

The application of the Ultimate Forward Rate (UFR) method forms a key part of the more stable assessment framework announced in the Outline Memorandum on the Financial Assessment Framework (*Hoofdlijnnnota FTK – Parliamentary Papers (Kamerstukken II) 2011/12, 32 043, no. 113*). The method leads to more stable interest rates for long maturities, particularly when there is turmoil on the financial markets.

In the report on the study into alternative risk-free interest rates for pension funds (*"Onderzoek naar alternatieve risicovrije rentes voor pensioenfondsen"*), as carried out by the ministry and De Nederlandsche Bank (DNB) and presented to the Dutch House of Representatives in a letter dated 17 May 2011 (Parliamentary Papers (*Kamerstukken II*) 2010/11, 32 043, no. 17), it was noted that the yield curve published by DNB, which is derived from the interbank swap market, cannot be considered to be indisputably the best predictor of the risk-free interest rate in the distant future beyond a certain maturity. The UFR method proposed in the context of Solvency II was also taken into consideration in the search for alternatives. The report provides information on the benefits and disadvantages of the UFR method and on a number of practical issues concerning the application of the method.

Before these practical objections are discussed in more detail, it is first necessary to consider the importance of ensuring the best possible approximation of the risk-free interest rate to be expected in the long term. This approximation is required in order to arrive at the best estimate of the value of pension fund liabilities³⁷.

In a sufficiently liquid market, the risk-free interest rate can be derived from the prices of traded instruments. If, however, the market is not sufficiently liquid, additional assumptions need to be made. In that case, if there is a reliable risk-free yield curve, including the UFR, established on the basis of sound economic principles, it will be possible to determine and

³⁷ See Solvency II Directive 2009/138/EC, Chapter VI, Section 2 Rules relating to technical provisions.

value the pension commitments of subsequent generations in such a way that the distribution among generations can also be considered reliable. If, at any time, it transpires that this yield curve has shortcomings in terms of being the best approximation of the risk-free interest rate, any distribution of pension commitments among subsequent generations that happens to be based on this yield curve would, by implication, also contain shortcomings. Applying a method that is intended to produce a realistic UFR, both now and in the future, will result in a distribution of the commitments among the generations that continues to form the best possible yardstick for determining whether the impact of certain policy measures will be generation-neutral or not. The committee is invited to give its view on dealing with such intergenerational effects in the event of future changes to the UFR.

In addition to the issue of how to determine the level of the UFR, the application of the UFR method for the yield curve as proposed in connection with Solvency II raises a number of additional questions, including the following:

Which maturity marks the point at which the market ceases to be deep, liquid and transparent enough for market data beyond this maturity to be considered reliable?

How should the forward rate contained in the last liquid point of the yield curve be extrapolated to the UFR and how quickly should this be done?

What are the consequences for pension funds with an investment policy that focuses, either partially or entirely, on the hedging of interest rate risks related to long-term liabilities?

Partly in view of the discussion that has arisen on the application of the UFR method, in the Outline Memorandum on the Financial Assessment Framework the government has indicated that it will consider ways of ensuring that the UFR is, and continues to be, realistic in changing economic circumstances. Advice on this matter is to be requested when the UFR Committee is established.

With regard to the application of the UFR method to the yield curve published by DNB since 30 September 2012, the proposals for Solvency II, in which a UFR of 4.2% is used, are to be followed for the period up to the end of 2013. This UFR consists of the long-term expected inflation rate of 2% and a real rate of interest of 2.2%. According to the background document "Risk-free interest rates – Extrapolation method"³⁸ for the Quantitative Impact Study 5 (QIS5), these expectations were derived from "Risk and Return in the 20th and 21st Centuries", a study by Dimson, Marsh and Staunton (Business Strategy Review, 2000, Volume 11 Issue 2, pp 1-18). The expected real rate is in line with the unweighted average of the real yield on bonds issued by the governments of Australia, Canada, Denmark, France, Germany, Italy, the Netherlands, Japan, Sweden, Switzerland, the United Kingdom and the United States

³⁸ https://eiopa.europa.eu/fileadmin/tx_dam/files/consultations/QIS/QIS5/ceiops-paper-extrapolation-risk-free-rates_en-20100802.pdf

from 1950 until 2000. The question here is whether a better approximation is possible. For this reason, the requested advice will include recommendations on the level of the UFR.

It was noted in the Outline Memorandum on the Financial Assessment Framework that EIOPA will set the final level of the UFR for Solvency II before the Financial Assessment Framework enters into effect, and following that it will also identify the method to be used to determine whether and when the level of the UFR needs to be adjusted. It was also noted that the grounds which led to the application of the UFR by insurers also apply equally to pension funds. This emphasises how important it is that the committee takes account of EIOPA's UFR-related activities. These include activities related to the method for ensuring that the level of the UFR is, and continues to be, realistic, and, for example, the method for determining the last maturity with a sufficiently deep, liquid and transparent market.

Moreover, the Quantitative Impact Study (QIS) performed by EIOPA in connection with the revision of the IORP Directive is also relevant. In this case, the UFR of 4.2% is also a part of the relevant risk-free yield curve that has to be taken into consideration in the QIS. In connection with this, a group of 20 academics supported the application of the UFR for that part of the yield curve that is not established on a sufficiently deep, liquid and transparent market³⁹. The group did, however, question the details of the proposed method, including the level of the UFR, and pointed out the danger of market distortions affecting the last liquid point.

In the case of the application of the UFR for the yield curve for pension funds, DNB has deviated from the method proposed by EIOPA in a move aimed at counteracting such dangers. The DNB application also makes use of market data that are still available beyond the last liquid point. This aspect should also be considered in the analysis aimed at arriving at a method that ensures the UFR is, and continues to be, realistic.

Pursuant to section 2 (1) of the Advisory Boards and Committees (Remuneration) Act, remuneration is to be granted to the members of the committee. The level of this remuneration is determined on the basis of the Civil Servants' Pay Decree 1984. The remuneration granted for each meeting amounts to 3% of the maximum for salary scale 18 as contained in appendix B of the Civil Servants' Pay Decree 1984. Pursuant to section 2 (3) of the Advisory Boards and Committees (Remuneration) Act, no remuneration will be granted to persons holding positions at institutions or organisations as referred to in sections 2 to 5 inclusive of the Executive Pay Financed from Public Funds (Disclosure) Act (*Wet openbaarmaking met publieke middelen gefinancierde topinkomens*) if their appointment or

³⁹ Academic community group, Response to "Draft Technical Specifications for the QIS of EIOPA's Advice on the Review of the IORP Directive: Consultation Paper" (<https://eiopa.europa.eu/consultations/consultation-papers/2012-closed-consultations/index.html>).

participation is due to the position they hold. These organisations include legal entities that perform a duty which is regulated by or pursuant to the law, such as the Netherlands Bureau for Economic Policy Analysis (CPB) and DNB.

Partly in view of the connection to EIOPA's work, the committee is to be given free rein to consult one or more external experts from the Netherlands and other countries.

When carrying out its task, the committee will handle confidential, price-sensitive information. Pursuant to section 2:5 of the General Administrative Law Act (*Algemene wet bestuursrecht*), a duty of confidentiality applies with regard to such information. The members of the committee have signed a confidentiality statement that contains further details of this duty of confidentiality. The duty of confidentiality also applies to the members' relationships with third parties. The committee is to ensure that all those involved in the committee's work maintain confidentiality.

The State Secretary for Social Affairs and Employment,

J. Klijnsma

Appendix 4. Discussion partners and consulted experts

Foreign external experts

Professor Zvi Bodie, Norman and Adele Barron Professor of Management, Boston University
Professor Stephen J. Brown, David S. Loeb Professor of Finance, Leonard N. Stern School of Business at New York University

Professor Andrew J.G. Cairns, Professor of Financial Mathematics, Heriot-Watt University

Professor Damir Filipovic, Swissquote Professor of Quantitative Finance, Ecole Polytechnique Fédérale de Lausanne

Professor Joshua D. Rauh, Professor of Finance, Stanford Graduate School of Business

Other discussion partners

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Appendix 5. Questionnaire for academics

Five foreign experts were sent the following questionnaire and information on the basic criteria formulated by the Committee. These experts made contributions on condition that their anonymity is guaranteed.

Dutch law states that pension liabilities are to be valued against the risk free term structure. Until September 2012 the risk free term structure was measured using market observations in the Euro-swap market up to a maturity of 50 years, assuming that even longer forward rates equal the rates in the last bucket.

- *Do you support adjustments of these market observations using a UFR curve to value pension liabilities?*

It has been proposed to value Dutch pension liabilities against a fixed discount rate (of say 4%) or to discount them against an estimate of the expected return on the underlying assets (as is the case e.g. in many US states).

- *Do you support these proposals or do you support the use of (some estimate of) the risk free rate?*

EIOPA proposes a level of 4.2% for the Ultimate Forward Rate in the Euro-swap market, on the basis of an empirical analysis described in http://eiopa.europa.eu/fileadmin/tx_dam/files/consultations/QIS/QIS5/ceiops-paper-extrapolation-risk-free-rates_en-20100802.pdf.

- *Please comment on the estimate and the motivation that is given. Do you see better alternatives to estimate the forward rate for very long maturities?*

The proposal is to use market observations on the yield and forward curves up to a maturity known as the Last Liquid Point, assuming that market liquidity drops sharply after that maturity.

- *Do you agree that liquidity drops sharply after a specific maturity? At what maturities is liquidity low?*

Competing proposals either give some or no weight to market observations for maturities after the point where the discount rate equals the observed yield.

- *Do you prefer gradual or abrupt adjustments in the weight for market observations at longer maturities?*

The committee would like to benefit from your expertise as much as possible.

- Please provide any comments or suggestions that you have on valuation of pensions and insurance liabilities in general and on measurement of a risk free term structure for Dutch pension liabilities in particular.

Appendix 6. Questionnaire for market participants

The following questionnaire was sent to the market participants consulted by the Committee. It consists exclusively of open questions.

How would you define market liquidity?

There are several known approaches to defining market liquidity. It may be linked to the average direct and indirect transaction costs for a “normal” transaction or to the cost of executing a small trade. Another approach is to look at the ability to trade high volumes without creating price effects. In case you have other indicators for assessing the liquidity in the (long-dated) EUR swap market, this would also be very welcome. Please indicate which measures of liquidity are most relevant in your view. If you have any other considerations that could be relevant for the commission, please share them with us.

How would you define and measure transaction costs?

One can distinguish various components of transaction costs, such as the direct transaction costs and market impact costs. Transaction size is probably an important aspect when assessing total costs. Please indicate how you would define “large” and “normal” market transactions and reflect on all relevant aspects.

How would you describe the liquidity in the long-dated EUR swap-market?

Is there according to your experience a significant difference in liquidity for 10-, 20-, 30- and 40-year swaps and beyond?

Or do you prefer to look at other maturity buckets? How do you assess liquidity before the Lehman bankruptcy, compared to the situation immediately after September 2008 and today? What is your prognosis of structural liquidity in these markets (incorporating the impact of regulatory changes, e.g. central clearing, financial transaction tax and Basle III)?

What is the last liquid point on the curve in your opinion?

How would you determine this point? Has this point changed over the past 5 years?

Additional considerations

Would rate levels themselves have an impact on market liquidity? Put differently: do you perceive asymmetry in market liquidity for rising and falling rate levels? (For instance, if rates rise there would be more two-way flows because more user-groups would enter the market)

How would you describe the impact that the UFR for pension funds – introduced in The Netherlands in September 2012 - and in particular the last liquid point has had on the swap market and the liquidity? Are there parallels to be drawn with regulatory changes in other markets, such as Sweden or Denmark? Are there parallels to be drawn with regulatory changes that apply to (life) insurers, specifically the UFR guideline?

UFR in general

What is your opinion about the current implementation of the UFR for Dutch pension funds?

In your opinion, what are prerequisites for any extrapolation method that uses a long term Ultimate Forward Rate?

Appendix 7. Technical details of the extrapolation method

The following basic criteria were used when deciding on the details of the method.

1. Up to the First Smoothing Point the nominal zero coupon rate term structure at time t is based on the euro swap curve for maturities of 1-10 years, 12 years, 15 years and 20 years at time t in accordance with the method set out in the Financial Assessment Framework. For extrapolation purposes, the zero coupon rates obtained in this way are converted into continuously compounded zero coupon rates using the following formula:

$$z_c(t, h) = \ln(1 + z(t, h))$$

2. For maturities in excess of 20 years, the nominal zero coupon rate term structure at time t is based on the following extrapolation method:
 - a) The UFR is equal to the moving average of the 20-year forward rates over the previous 120 months. This is reassessed once a month.

Where $M(t)$ is the set of 120 successive month-ends immediately prior to time t , the following calculation is performed to obtain the UFR:

$$UFR(t) = \frac{1}{120} \sum_{m \in M(t)} f(m, 20, 21)$$

Here, $f(m, k, k + l)$ is the k -year forward rate with maturity l at time m .

The value obtained for $UFR(t)$ is normally rounded off to one decimal place.

In addition:

$$UFR_c(t) = \ln(1 + UFR(t))$$

- b) A Last Liquid Forward Rate (LLFR) is estimated once a day using the post-FSP zero coupon rates for maturities of 25, 30, 40 and 50 years as observed at the end of each calendar day, as follows:

$$f_c^*(t) = \alpha f_c^*(t-1) + (1-\alpha)w \left(f_c(t, 20, 25) + \frac{1}{2}f_c(t, 20, 30) + \frac{1}{4}f_c(t, 20, 40) + \frac{1}{8}f_c(t, 20, 50) \right)$$

We propose the following weightings:

$$\alpha = \frac{1}{2}$$

$$w = \frac{8}{15}$$

The factor $f_c^*(t)$ describes a moving weighted average of the forward rates after the Last Liquid Point. The α parameter that is selected determines how much weight is given to new market data compared to the previous observation. This means that large, random deviations can be mitigated. Major deviations are only included in $f_c^*(t)$, if they turn out to be structural. This parameter is calibrated for the interest rate sensitivity of the technical provisions. A value that is set too low leads to an interest rate sensitivity that is comparable to the Smith-Wilson method, while a value that is set too high leads to excessive sensitivity in the long end of the curve when compared to the current method. The method requires a starting value for the recursion of $f_c^*(t)$. Data going back to 1 January 2003 were used for establishing and analysing the method. The initial starting value $f_c^*(0)$ therefore relates to 1 January 2003. Owing to the very long recursion, the current value of $f_c^*(t)$ has, in the meantime, become insensitive to the initial starting value and therefore now depends exclusively on the value of the other parameters. The starting value used for the analysis is $f_c^*(0) = UFR_c(t)$.

c) Post-FSP forward rates after the FSP are extrapolated as follows:

$$f_c(t, 20, 20 + h) = UFR_c(t) + (f_c^*(t) - UFR_c(t))B(h)$$

The function $B(h)$ is equal to: $B(a, h) = \frac{1 - e^{-ah}}{ah}$ where $a = 0.10$.

d) Post-FSP zero coupon rates are extrapolated as follows:

$$z_c(t, 20 + h) = \frac{20z_c(t, 20) + hf_c(t, 20, 20 + h)}{20 + h}$$

4) Depending on the application, the continuously compounded zero coupon rates that are obtained can be converted into annual compound zero coupon rates using the formula $z(t, 20 + h) = \exp(z_c(t, 20 + h)) - 1$.

Appendix 8. Modelling the yield curve

The prices observed for zero coupon bonds form the starting point for modelling the yield curve. The price observed at time t for a zero coupon bond with maturity l is defined by $D(t, l)$.

Zero coupon rates

The prices of zero coupon bonds can also be defined using zero coupon rates (also known as spot rates). If we use continuously compounded rates as a basis, then zero coupon rate $z_c(t, l)$ with maturity l is defined as follows:

$$z_c(t, l) = -\frac{1}{l} \ln D(t, l)$$

Forward rates

In addition to zero coupon rates, forward rates also play a significant role. The forward rate $f_c(t, u, u+l)$ is the rate we can agree today at time t for a sum of money deposited with the bank for l years in u years' time, i.e. from $t+u$ to $t+u+l$. Forward contracts therefore involve a period of deferment (u) as well as a maturity (l). Forward rates can be calculated on the basis of the zero coupon rates z_c . The formula for the continuously compounded forward rate $f_c(t, u, u+l)$ is as follows:

$$f_c(t, u, u+l) = \frac{z_c(t, u+l)(u+l) - z_c(t, u)u}{l}$$

Instantaneous forward rates are a special kind of forward rate. These are obtained if we consider the limit for $l \rightarrow 0$ in $f_c(t, u, u+l)$. These instantaneous forward rates are defined by $F_c(t, u)$ and are given by the following formula:

$$F_c(t, u) = \frac{\partial z_c(t, u)u}{\partial u}$$

Affine term structure models

The affine terms structure models constitute a special class of models that are used to model the yield curve. Early examples of such models include Vasicek (1977) and Cox et al. (1985). The general class of affine term structure models was introduced by Duffie and Kan (1996). Affine term structure models assume the following definition of the zero coupon rate z_c :

$$z_c(t, l) = A(l) + B(l)x(t)$$

In this formula, the functions $A(l)$ and $B(l)$ depend exclusively on maturity l (and not on t), and $x(t)$ is a stochastic factor that affects interest rates. The extent to which the x factor affects maturity l is defined by the function $B(l)$. The general formulation of affine models may include several factors that affect interest rates. However, there is only one factor that matters for the very long maturities in which we are interested.⁴⁰

A significant decision that is made when modelling the yield curve concerns the definition of the function $B(l)$. If the zero coupon rates for very long maturities converge to a stable level, this means that the impact of the x factor on interest rates must continue to decline as the maturity l increases. The function $B(l)$ therefore needs to be a declining function of l , where $B(l)$ falls to 0 before l approaches infinity. The definition of the function $B(l)$ proposed by the Committee is based on the Vasicek (1977) model and is shown below:

$$B(l) = \frac{1 - e^{-al}}{al}$$

In this definition, where $a > 0$ the function $B(l)$ always falls to 0 before l approaches infinity. The parameter a is known as the convergence factor and shows how rapidly the function $B(l)$ is declining towards 0. If a is very low, the function $B(l)$ will decline very slowly, whereas if a is high the function $B(l)$ will rapidly fall to 0 as l increases.

If we use the affine form $A(l) + B(l)x(t)$ for the zero coupon rates, we obtain the following for the forward rates:

$$f_c(t, u, u + l) = \left(\frac{A(u + l)(u + l) - A(u)u}{l} \right) + \left(\frac{B(u + l)(u + l) - B(u)u}{l} \right) x(t)$$

This means that the forward rates also follow an affine structure, albeit with different "A" and "B" functions. In the case of long periods of deferment u and maturities l , the forward rate will

⁴⁰ The other factors only affect short-term interest rates.

converge to the Ultimate Forward Rate. To simplify matters, let us assume that the “A factor” in the forward formula is a good approximation of the continuously compounded UFR. This then gives us the following formula:

$$f_c(t, u, u + l) = UFR_c + \left(\frac{B(u + l)(u + l) - B(u)u}{l} \right) x(t)$$

If we now fill in the specific functional form of the Vasicek model for $B(l)$, we obtain the following:

$$f_c(t, u, u + l) = UFR_c + B(l)e^{-au} x(t)$$

In this formula we can indeed see that the term $B(l)e^{-au}$ reaches 0 in cases where the value of l is high and also where u is high, and therefore that the forward rate converges towards the UFR_c . The rate of convergence to the UFR_c is determined by the convergence factor a .

With regard to the instantaneous forward rate, we then obtain the following expression:

$$F_c(t, u) = UFR_c + e^{-au} x(t)$$

We can use this last formula to express the unknown x factor in terms of the UFR_c and the instantaneous forward rate: $e^{-au} x(t) = F_c(t, u) - UFR_c$. If we use this last expression to complete the formula for the forward rate $f_c(t, u, l)$, we obtain the following:

$$f_c(t, u, u + l) = UFR_c + (F_c(t, u) - UFR_c)B(l)$$

This last formula forms the basis for the extrapolation formula for the forward rates as contained in Appendix 7, in which the UFR_c was replaced by the estimated UFR (involving a laborious transformation) as based on the average of the 20-year forward rates for the previous 120 month-ends.

Estimate of instantaneous forward rate $F_c(t, u)$

In the previous section we saw how the x factor is linked to the instantaneous forward rate $F_c(t, u)$. Unfortunately, the instantaneous forward rate cannot be observed directly. We can, however, use zero coupon rates to make observations of ‘regular’ forward rates with maturities of $l > 0$.

As we are particularly interested in extrapolating the yield curve for very long maturities, we will want to determine the instantaneous forward rate $F_c(t, u)$ (and hence the x factor) using the observable forward rates $f_c(t, u, u+l)$ after the First Smoothing Point (FSP), where u is an FSP of 20 years, and l consists of maturities of 5, 10, 20 and 30 years. We therefore use a number of different forward rates in an effort to estimate the instantaneous forward rate $F_c(t, u)$. The problem we encounter at this point is that the forward rates $f_c(t, u, u+l)$ do not provide perfect information on $F_c(t, u)$, and are themselves 'contaminated' because the market becomes less and less liquid as maturities increase.

This raises the question of how we can still make a reasonable assessment of the instantaneous forward rate $F_c(t, u)$ using these 'contaminated' observations. The method we use for this is based on the Kalman filter. The precise derivation and implementation of the Kalman filter involves very complex mathematics, and we refer to the articles by Babbs and Nowman (1999) and De Jong (2000) for a description.

By contrast, the thinking behind the Kalman filter is simple to explain. As the observations are 'contaminated', the Kalman filter tries to combine information from various sources in order to produce a better estimate. It does so in two ways. First, it takes a weighted average of the various forward rates that are being observed. Each of the weightings is adjusted to reflect the quality of the information obtained from each forward rate. In our application, we give forward rates with maturities close to the FSP greater weight than forward rates with long maturities that are far beyond the FSP. Second, the Kalman filter takes a weighted average of the last estimate of the previous day and new information obtained from the forward rates for the current day. Both of these elements are incorporated in the Kalman filter estimator f_c^* :

$$f_c^*(t) = \alpha f_c^*(t-1) + (1-\alpha)w \left(f_c(t, 20, 25) + \frac{1}{2}f_c(t, 20, 30) + \frac{1}{4}f_c(t, 20, 40) + \frac{1}{8}f_c(t, 20, 50) \right)$$

In this formula, α is the weighting given to the previous day's estimate. In addition, we can see that the weightings of the post-FSP forward rates are constantly halved to approximate the declining liquidity. The w factor provides an unbiased weighted average of post-FSP forward rates. The estimated value $f_c^*(t)$ is used as an approximation for the instantaneous forward rate $F_c(t, 20)$ in the extrapolation formula for the forward rates.

Appendix 9. Considerations regarding the forward rate

Forward rate and expected interest rate

There are two factors that lead to discrepancies between the expected interest rate and the forward rate. These are the interest risk premium and a statistical adjustment factor known as the convexity adjustment.

A few definitions are required in order to explain these concepts. We will take as our starting point a bond that is to be traded at a certain point in the future. The future price of this bond is P . This price is not yet known and depends on what the interest rate (R) will be when the bond is traded. In the case of a one-year bond with a yield of 1 (face value plus coupon rate), the price is calculated as follows:

$$P = \frac{1}{1 + R}$$

It is already possible to conclude a contract fixing the price – and hence the interest rate – of this bond. This can be done at the predetermined, or forward, price (F) and at a predetermined, or forward, rate (R_F), where:

$$F = \frac{1}{1 + R_F}$$

The price and interest rate are already fixed and determine the conditions governing the future delivery of the bond.

a) Interest risk premium

The difference in the level of security offered by a forward rate and the actual interest rate is expressed in the interest risk premium. The interest risk premium⁴¹ (π_R) reflects the difference

⁴¹ In principle, the interest risk premium may be positive or negative, depending on whether the market finds a fixed rate more appealing than an uncertain rate. A fixed rate offers more security in terms of sums of money, but it does not in terms of purchasing power. A fixed forward rate is therefore more sensitive to surprise jumps in inflation than actual future interest rates, which will move up and down as the rate of inflation changes. Other factors also determine the attractiveness of fixed rate contracts

between the required yield on a bond with an unknown price (which depends on future short-term interest rates) and a bond whose face value is already fixed. To be precise, this premium is calculated by comparing the expected price $E[P]$ of a one-year bond with the known forward price of that bond (F):

$$E[P] = F(1 + \pi_R)$$

If the interest risk premium is positive ($\pi_R > 0$), the expected value of the bond with an uncertain price must be higher than the value would be if it were fixed now. Barrie and Hibbert (2010) have estimated this interest risk premium to be -1.5% for forward prices for the far-distant future. The expected value of the bond with the unknown price $E[P]$ is less than that of the bond with the known price (F). A bond with an unknown interest rate is considered to be more appealing than a bond with a fixed face value.

b) Convexity adjustment

Owing to the inverse relationship between the interest rate and the price, the expected interest rate is not equal to the inverse of the expected price. Instead, there is an adjustment for convexity (q) which depends on the variation in interest rates. The relationship between expected interest rates and the expected price can be approximated as follows:

$$E[R] = \frac{1 + q}{E[P]} - 1$$

The convexity adjustment q is roughly equal to $\frac{1}{2}\text{Var}(R)$ where $\text{Var}(R)$ is the variance in interest rates. Barrie and Hibbert (2010) have estimated this convexity adjustment to be equal to 0.4%.

If we take these two factors together, we obtain the following for the relationship between the forward rate and the expected interest rate:

$$E[R] = \frac{(1 + q)(1 + R_F)}{1 + \pi_R} - 1$$

And hence, as an approximation:

$$E[R] = R_F + q - \pi_R$$

compared to contracts with unknown interest rates, such as the correlation to the economic cycle. All of these factors can be covered by the interest risk premium.

The sum of the interest risk premium and the convexity adjustment is related to the difference between short-term and long-term interest rates in the yield curve. In the longer term, short-term interest rates are on average 0.8 percentage points lower than long-term interest rates (Van Ewijk et al, 2012), although the difference fluctuates depending on the state of the economy. In June 2013, when long term interest rates stood at 1.9% and short term interest rates at 0.5%, the difference was 1.4 percentage points.

Forward price equal to risk-neutral expectation of the price

The expectation of the price $E[P]$ used in the above example is the actual statistical expectation, specifically the mean of the probability distribution. Financial theory makes frequent use of risk-neutral expectations ('expectations under Q '): In such cases, the probability distribution is weighted to reflect the risk aversion of consumers. In the risk-neutral world, the forward price F is equal to the risk-neutral expectation of the actual price. The forward rate is therefore equal to the risk-neutral expected future interest rate, with a small adjustment for convexity.

Real and nominal rates of interest

The nominal rate of interest is important when it comes to nominal pension commitments, while the real rate is used for real commitments. A real commitment provides protection from inflation. The real rate is established in the market for index-linked loans, which exists in many countries but not in the Netherlands. The difference between the interest rate on an inflation-indexed loan and the rate on a nominal loan consists of two elements: expected inflation, and an adjustment for the inflation risk premium. This gives us the following:

$$\text{nominal rate (fixed)} = \text{real rate (fixed)} + \text{expected inflation} + \text{inflation risk premium}$$

The third of these elements follows on logically from the fact that a debt instrument bearing interest at a nominal rate is less attractive than a debt interest bearing interest at a real rate owing to the uncertainty surrounding inflation. In practice, this is not a major factor. Bekaert (2010) obtained an inflation risk premium in the order of 0-0.3 percentage points. Garcia and Werner (2010) arrived at an inflation risk premium of 7 basis points for a maturity of one year and a premium of up to 25 basis points for longer maturities. Currently, the difference between the nominal rate and the real rate for a 10-year maturity is approximately 1.8% for the euro area (Agence de Tresor, 2013). This difference is sometimes referred to as the breakeven inflation rate. Following adjustment for the risk premium there is a further, slight fall in expected inflation, whereby a risk premium of 25 basis points results in expected inflation of 1.6%. This is slightly less than actual inflation in the Netherlands over the past ten

years, which averaged 1.8%. In the longer term, the breakeven inflation rate is slightly higher, but after an adjustment for the risk premium the implied inflation expectation is still less than 2%.