Technical description of the new interest rate curve

The interest rate curve consists of three segments:

a) The short-term segment – maturities from 0-2 years
b) The mid-term segment – maturities from 7-20 years
c) The long-term segment – maturities above 20 years

Maturities between 2 and 7 years are calculated with linear interpolation.

a)
The discount rates in the short-term segment from 0-2 years are derived from the weighted effective interest rates on the RTLs (Danish fixed mortgage bullets funding ARMs) included in Nykredits Danish Mortgage Bond Index. The interest rates are weighted similar to the composition of Nykredits Danish Mortgage Bond Index at their nominal amounts on the latest rebalancing date.

b)
The discount rates in the mid-term segment from 7-20 years are based on euroswap rates. These rates are adjusted by the moving average of the spread between Danish and German government bonds and half of the option adjusted spread between Danish mortgage bond and the Danish swap curve (OASSwap).

The moving average of the government bond spread is calculated as an equal weighted average of the last 250 daily observations of the spread between Danish and German government zero-coupon rates measured at the 10 years maturity.

Both the moving average of the government bond spread and the option adjusted spread are floored at 0 bp. The euroswap curve is hence the floor for the discount rates in the mid-term segment.

The discount rates for maturities 7-20 years can be described as follows:

Euroswap(t)
+ max[0; average (DKgov(10)-DEgov(10))]
+ 0,5*max[0; OASswap]

Maturities in the mid-term segment from 7-20 years where no market data are available are calculated with linear interpolation.

c)
The discount rates in the long-term segment above 20 years are calculated with the Smith-Wilson extrapolation method.[1] Input to the calculation is spot rates form the segments 0-20 years, but the extrapolation is done by use of forward rates. Output is a spot rate interest curve to be used to discount insurance liabilities. The extrapolation method uses the normal relationship between spot rates and forward rates.

The spot rate curve used as input to the extrapolation contains both the moving average of the government spread and half of the option adjusted spread. This implies that both the government bond spread and the option adjusted spread are implicitly included in the extrapolated part of the interest rate curve.

The method includes three significant parameters:
i. The Ultimate Forward Rate (UFR), which is set at 4.2 % corresponding to the current suggestion in Solvency II. Based on European data the long-term expected inflation target is 2 % and the long-term expected real-growth is 2.2 %. The 2.2 % are calculated on historical observations of real return on bonds.
ii. The number of years from the last liquid point (20 years) to the point where UFR should be reached. This parameter is set at 10 years.
iii. The speed of convergence. This parameter is named "alpha". This parameter is dependent on the period chosen in (ii). The shorter period the faster convergence is needed. The parameter value is set at the lowest possible value given that forward rates converge to UFR at the 30-year point.

It is noted that the value of alpha as a starting point is set at 0.1, but that the condition of convergence of forward rates to 4.2 % in the 30-year point is not always possible to fulfill with alpha 0.1. This is solved by increasing the value of alpha iteratively by 0.01 until convergence is achieved. Convergence is defined as being a deviation from UFR in the 30-year point of maximum +/-3 bp. At low levels of interest rates in the 20-year point like current observable it is necessary to set a higher value of alpha to ensure convergence.

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[1] The mathematical background and a further discussion can be found in: Smith A. & Wilson T. – "Fitting Yield curves with long Term Constraints" (2001), Research Notes, Bacon and Woodrow.
Calculations are done in the excel sheet available on the Danish FSA web page.