

NASDAQ OMX Copenhagen

Guidelines for

Yield Calculation, etc.

December 2010

(This document replaces the December 2000 Guidelines in the English language)

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1. Introduktion

This booklet contains information about the calculation of yields, duration, adjustment factors, index factors, revaluation factors and average yields on NASDAQ OMX Copenhagen A/S (NOC). These variables/factors together with various share indices are referred to as derived calculations, referring to the fact that all these calculations are based on price information originating from the electronic trading and information systems.

Consequently, these variables are also part of the “value added”, which is generated on NOC, as they contribute more information than simply the reported price and turnover, which are disseminated via the electronic trading and information systems of NOC.

Each trading day NOC’s calculations of yields etc. are published in the electronic information system, on the website of NOC and as a pdf document in the Official List.

This booklet is primarily a presentation of the rules regulating the calculation of derived calculations in respect of bonds and bondlike securities. Moreover, at the back of these Guidelines is a technical appendix containing the essential formulas for the calculation of yield, duration etc.

In section 2 the general assumptions are described, i.e. the basic rules of yield calculation etc. which apply to all bond types and series. In section 3 the assumptions in respect of the specific types of loans are described.

In sections 4 and 5 the actual calculation of yield and other derived risk and return measures is described.

Section 6 describes the calculation of average yield on bond groups, and section 7 describes the calculation of the various index factors published by NOC.

2. General assumptions

This section describes the general assumptions, i.e. the basic rules regulating the calculation of yield, duration, adjustment factors and revaluation factors on NOC which apply to all bond types and series.

Cash flows

It is assumed that the due dates (interest payment dates) and repayment dates coincide, i.e. the creditor receives the payment of interest and installments at the same time, which in fact - with very few exceptions - applies to all bond series listed on NOC. NOC's calculations of yield etc. are all based on the cash flow of the individual bond series, which is either projected by NOC's yield calculation system or supplied by the bond issuer. When the cash flows are projected, the volume in circulation is fixed at DKK 10 million at the opening time (or rather 10 million units of currency measured in the currency of issue). However, externally supplied cash flows always involve unpaid debts corresponding to the volume in circulation of the bond in question at the time of calculation/settlement. The registered volume in circulation may, however, differ from the actual unpaid debts of the series as a consequence of immediately terminated (called) and redeemed loans in respect of which the bond issuer has not yet had the underlying bonds cancelled.

Synthetic cash flow projections

Synthetic cash flows are projected for the following loan types:

- bullet loans (where the principal sum is repaid in the final bullet)
- open-ended annuity loans
- open-ended serial loans
- open-ended index-linked loans
- all irredeemable loans (i.e. the principal is never repaid)

Synthetic cash flows are also projected for certain floating rate notes, cf. section 3.1.

NOC projects synthetic cash flows for all open-ended series, i.e. series in which new issues may be made, where loans are issued to debtors. The projection of the cash flow is made up to the first supply after the series has been closed. Hereafter, the cash flows supplied by the issuers are used for the yield calculation.

It naturally follows that the cash flow of the bond

reflects the cash flow on the debtor side, but the cash flow of the bond will not necessarily follow the typical cash flow of the underlying type of loan. This will only be the case if the opening period is one coupon payment period and/or the last creditor repayment date is equal to the last debtor repayment date for all debtors, i.e. the debtor's term is not the same for all borrowers, but depends on which tap (issue) period the loan was granted in.

When synthetic cash flows are projected, the fact that in certain cases (e.g. in connection with replacement of loans) loans with a life shorter than the maximum possible life in the series are granted (e.g. an 18-year loan in a 20-year series) is not taken into account.

For bullet loans and irredeemable loans it is not a requirement that cash flows be supplied, and as a consequence synthetic cash flows are often used in the yield calculation throughout the whole life of the series.

If the issuer supplies the cash flows of such loans, these will, however, be used in the yield calculation after the series has been closed in the same way as is the case with other types of loan.

Supply of cash flows

Cash flows are supplied for the following types of loan:

- all open-ended series in exception of bullet loans and irredeemable loans
- all closed series in exception of bullet loans and irredeemable loans
- closed index-linked loans, including agricultural loans

In respect of the above closed series the cash flows supplied by the issuing agents shall be used in the yield calculation as from the first supply of cash flows after the series has been closed.

Cash flows shall be supplied by the mortgage banks four (4) times annually, inter alia as a consequence of any prepayments which may affect the distribution of repayments in terms of time. This will be the case when the distribution of the redeemed loans does not comply with the distribution of the original lending/inflow of loans.

The cash flows shall be settled as at the first trading day after 31 March, 30 June, 30 September and 31 December and shall be supplied to NOC no later than the 12th trading day after these dates. The cash flows shall be published as soon as possible upon receipt.

The issuing agents shall also supply cash flows of open series in order to give the market participants an insight into the “actual” cash flow. However, the supplied cash flows of open series are not used for yield calculation as the calculation of these “actual” cash flows disregards the inflow of loans within the remaining tap periods.

For further information, please refer to the disclosure requirements applicable to issuers of listed securities in force from time to time.

The principle of compound interest

NOC employs the principle of compound interest in all yield calculations, assuming all returns (coupon payments) are currently reinvested at a rate of return equal to that of the original investment (the purchased bond). The yield is thus the return on investment received by an investor from a bond held to maturity where the rate of interest remains unchanged. Interest is always stated as the rate of interest per annum (annual yield).

Price basis

The price basis for the yield calculation (the yield calculation price) is the most recent of the following prices:

1. The All trades average price at the end of the day.
2. The best bid at the end of the day.

The definitions of these price concepts can be found in NOC’s Guidelines for the publication and calculation of prices etc.

Where more prices occur on the same day, the price information shall be ranked according to the above order of succession.

The price used for the calculation of yields is in bold type in the Official List and in the field “calculation price” on NASDAQ OMX Nordic webpage.

Amount invested

The amount invested is used as the basis of the yield calculation etc., i.e. the amount actually invested; the accrued interest is thus taken into account. The amount invested equals the market

value to which accrued interest (positive or negative) has been added. Settlement may be cum or ex coupon, respectively.

With the change in market conventions on 8 February 2001 the ex coupon period was abolished for almost all Danish bonds etc., for which reason trading will be cum coupon right up to the coupon due date.

However, a few Danish and foreign bonds will continue to be traded with an ex coupon period of typically 1 calendar month (30 interest days in the case of the 30E/360 convention), and this will be taken into account when calculating the yield etc. of these bonds.

The calculation of accrued interest is done by calculating the share of the coupon that the buyer must pay to the seller (cum coupon) or receive from the seller (ex coupon) on the next coupon due date. The share shall be calculated as the number of interest days as from the last coupon due date and up to (excluding) the settlement date divided by the number of interest days of a whole coupon period. When using the actual/actual convention, the number of interest days will correspond to the number of calendar days. Thus, if the settlement date is exactly in the middle of a payment period, the buyer shall, in addition to the price, pay the seller an amount corresponding to half of the coupon.

The yield calculations etc. disregard any brokerage and other trading costs.

Calculation as at settlement date

As the payment and transfer of the bonds are made on the settlement date and not on the trade date, the yield etc. is calculated by attributing the amount invested and the discounted value of the cash flow to the settlement date.

In respect of all bonds denominated in DKK and bonds issued in a foreign currency registered with the Danish Securities Centre (Værdipapircentralen, VP), the standard clearing and settlement period is 3 trading days after the trade date; the standard clearing and settlement period for Treasury bills is 2 trading days. Other bonds traded on NOC may have a longer (or shorter) settlement period. The length of the settlement period will always appear from the prospectus of the series in question.

Calculation of creditor yields

The yield calculation system is a creditor system, i.e. the yield etc. is calculated from a

creditor's (bondholder's) point of view. Thus, only the amounts from the debtors which go to the creditors are included in the cash flows, i.e. installments and interest exclusive of contributions etc. to reserve and administration funds etc. The creditor's point of view has been chosen as the creditor yield is a decisive factor in the consideration of whether to buy or sell bonds.

It is assumed that the drawing of the individual investor's bonds equals the debtor's installments (drawing chance) for the series as a whole. The true yield is thus the annual return on the investment up to the time when the series expires. It is thus assumed that the bond is kept until it is redeemed. *The yield calculation does not take into account the effect of prepayments.*

Drawing procedures

The yield etc. is calculated - irrespective of whether mathematical drawing or number drawing (drawing of lots) is employed - on the assumption that investors have amounts drawn in proportion to the average drawing chance of the series. The drawing chance is defined as the ratio of the total amount which goes to installments in the coupon period in question to the total unpaid debts of the bond series (corresponding to the average drawing percentage).

When using the mathematical drawing model, which has been the standard model for the mortgage banks since 8 February 2001, installments are distributed in such a way that all investors each have a share of their holdings of the bond in question drawn which corresponds to the drawing percentage. The drawing percentage is calculated to ten (10) decimal places. The amount drawn is rounded to the nearest 0.01 unit of currency.

When using the number drawing model, lots are drawn among the bonds in circulation of each individual series. Thus, the creditor will either have his bond fully redeemed, at par normally, or will get no share of the installments at all. However, the principal rule is that creditors with major bond holdings may expect to comply with the average drawing chance of the individual series, whereas it is more of an actual drawing of lots for the minor investors.

Publication

The bonds drawn (actual amount) are usually announced (published) approximately half a settling period prior to the coupon due date in question. NOC adjusts the yield calculation on the trading day after publication so that the installment

for the next coupon due date is not included in the yield calculation.

The corresponding coupon payment is adjusted accordingly so it corresponds to the circulating volume after installment.

The drawing procedure of the Danish Securities Centre (VP Securities A/S) and VP Lux is to the effect that all trades which are settled on the drawing and publication date shall be cleared and settled prior to the drawing, for which reason the investor will participate in the drawing already on the settlement date.

In the calculation of the yield NOC assumes that only deliverable, i.e. non-drawn bonds are traded. This implies that bonds bought for settlement after the day of publication does not take part in drawings for the upcoming repayment date.

In series where the loans are granted as bullet loans with the same maturity year for the creditor and all the debtors (the opening period is one coupon payment period or debtor's terms (debtor repayment periods) differs), or where the loans are irredeemable, lots are not drawn continuously, and therefore the publication dates of such series are immaterial.

The yield calculation stops at the latest when the settlement date equals the date of publication associated with the last installment due date.

In respect of bullet loans with more opening periods and where the debtors of the series have repayment periods of the same length, the creditor side will not appear as a bullet loan. In these cases lots will be drawn in the last coupon payment periods (a number corresponding to the number of tap issue periods) as the loans are redeemed. However, no lots will be drawn during the last period as the entire remaining loan will be repaid.

Yield etc. after tax

NOC also calculates post-tax yields. For a more detailed description, please see section 4.3.

Interest days

At NOC's yield calculation system calendar days will normally be used in connection with yield calculation etc. as from 8 February 2001, as from that date the vast majority of bonds has been governed by the actual/actual convention (ISMA rule no. 251), which implies that interest days (the number of them) are counted as calendar days and that the number of days of a coupon payment period (or year) is the actual number of calendar

days of the coupon payment period (or year) in question. However, a few bonds are still governed by the 30E/360 convention, i.e. calculations are based on years of 360 days and months the length of which is 30 days.

In the latter case, interest days are calculated according to the following rule:

Where the settlement and/or repayment date is not an end-of-period date, interest days in the current month (the settlement month) and the repayment month shall be calculated as the difference between the days which have passed and the 30 interest days of the month. All other months are set at 30 days.

The chosen interest day convention is used in connection with the calculation of accrued interest as well as the calculation of yield, duration and adjustment factors, but see the section on calculation of yield etc. on Treasury bills, where the yield is calculated according to the bond market convention as well as the money market convention.

Steady inflow during tap issue periods

In connection with the projection of cash flows the distribution of lending during the opening period of the individual series must be estimated, as it will have an effect on the distribution of repayments to the creditors.

Bond issuers often issue loans in the same series over several coupon periods, typically a number of

coupon periods corresponding to a period of 3 years. The debtor repayment period is often different from the creditor repayment period as the creditor faces a repayment period equal to the sum of the debtor repayment period and the opening period. If the series is open for e.g. 3 years and 20-year loans are issued to the debtors, the creditors will have a series with a repayment period of approximately 23 years.

It also applies that even though e.g. pure serial loans or annuity loans are granted to the debtors, the creditors will not see their cash flow as a serial or annuity sequence due to the continuous inflow of new loans.

NOC has decided to work with a steady inflow of loans to the tap issue periods, i.e. the amounts of loans flowing to the series during each of the open coupon periods are equal in size. If the open coupon periods vary in length, so that for instance the first coupon period is only open for half the length of a normal coupon period, the calculation will take this into account as the inflow will then be halved. Thus, the inflow will correspond comparatively to the length of the opening coupon period. A simpler assumption is used for the floating-rate bond series namely the amounts flowing to the series are equally in size at each coupon period

In connection with the change-over to supplied cash flows after the series has been closed, the yield may “leap” as the supplied cash flow will be based on the actual distribution of inflows among the open coupon periods.

3. Assumptions in respect of specific loans

3.1 Nominal loans

Nominal loans include all loans where the principal, unpaid debt, installments etc. are not index-linked, i.e. the conventional types of loan. Nominal loans are granted in accordance with various principles which determine the repayment profile, i.e. annuity loans, serial loans, bullet loans and irredeemable loans and various combinations hereof.

The loans may have a fixed or floating coupon just as the life, coupon rate, number of coupon periods per annum etc. may vary.

There are only a few more assumptions to be made in respect of these loans than the general assumptions stated in section 2.

Floating-rate bonds

The coupon rate of the floating-rate bonds listed on NOC at present is typically adjusted each or every second coupon period.

There are also a number of other floating-rate bonds listed on NOC. Some of these refer to, e.g. a currency basket, a share or an index. The yield is not calculated for these kinds of bond series.

For some of the "old" floating-rate bonds the coupon rate is fixed each period according to a simple average of the daily reference rate of a reference period. The reference period is three months in respect of all these "old" floating-rate securities. In respect of floating-rate government bonds, the reference period runs from 6 months and 10 days before the coupon date to 3 months and 10 days before the coupon date. In respect of floating-rate bonds issued by mortgage banks, the reference period runs from 6 months and 20 days before the coupon date to 3 months and 20 days before the coupon date.

The reference rate is the average pre-tax yield on government fixed-rate securities with a remaining life of less than 3 years. The reference rate is published daily on NOC's website: Average bond yield, group 1 - remaining life of less than 3 years.

In order to calculate the yield the cash flow of a bond series must be known. The coupon of floating-rate bonds is changed each or possibly every second coupon period, and therefore the cash flow is only known one coupon period ahead.

The new coupon rate is entered in the reference data (no sooner than the trade date for which the settlement date is equal to the coupon due date). As from that moment the assumption of NOC's interest calculation is that the new coupon rate is valid throughout the remaining life of the bond.

The calculation of yield on the "old" floating-rate bonds is made on the assumption that the day's reference rate continues throughout the remaining life of the bond. By doing so all existing information on the future coupons which the market has on the basis of the reference rates is used on a current basis.

The coupon of the present coupon period is known. In the next coupon period the coupon is determined as an average of the reference rate of the past part of the relating reference period and an assumed coupon for the rest of this reference period equaling the reference rate of the day of calculation. At the end of the present coupon period the whole reference period for the next coupon period has passed, and therefore the exact coupon of the second coming coupon period is also known. Where this is the case the calculation of the coupon for the coupon period succeeding this one follows the procedure described above. The coupon of all other coupon periods is fixed at the reference rate of the day.

Accordingly, the yield is computed on the basis of the same principles as the yield on fixed-rate nominal bonds, except that the cash flow itself is updated each trading day on the basis of the daily calculation of the reference rate of the day.

3.2 Index-linked loans

Index-linked loans are loans whose principal, unpaid debts, installments and/or debt service are adjusted by use of one or more public index numbers.

All general assumptions also apply to the calculation of yield etc. on index-linked loans, and therefore only the specific assumptions which must be used in order to calculate yield etc. on these types of loan are described here. For further information on the working out of index-linked loans, please see the Orders and Circulars of the Danish Ministry of Economic and Business Affairs regarding the issue of index-linked loans.

The coupon of index-linked bonds is a real coupon (the rate disregards the inflation element), and consequently the calculated yield etc. will be expressed in real terms. In return for the low interest payment the remaining debt is indexed, and compensation for inflation is thus obtained via an adjustment of the creditor's credit balance.

Please note that the real yield shall be seen in relation to the index used, and that a "pure" real yield only exists to the extent that the index in question reflects the actual development of prices in society.

The cash flows are updated when NOC receives information on the new price indices and possibly the pay indices from Statistics Denmark (Danmarks Statistik). In respect of coupon periods that lie beyond the most recently regulated coupon period zero inflation is assumed.

The index factor of a given coupon payment period is known approximately one year prior to this coupon period as it is calculated on the basis of the semiannual percentage change in the net consumer-price index between 19 and 13 months prior to the coupon date. At 30 June 2010 the index factor is thus based on the change in the net consumer-price index from November 2008 to May 2009. As the net consumer price index of a given month is published approximately on the 20th of the following month, the index factor is calculated approximately one year prior to the coupon date to which it applies. In the above example the index factor of 30 June 2010 has been calculated approximately on 20 June 2009.

Accrued interest on index-linked loans

In connection with the calculation of the accrued interest to be used in the calculation of the amount invested the index factor of the settlement date shall be applied. The settlement amount as a whole shall generally be determined by using the index factor of the day applicable to the type of index linked loan in question. *However, in connection with the yield calculation accrued interest is made up in real terms, i.e. the accrued interest is calculated in real terms (on the basis of the coupon).*

Types of index-linked loans/bonds

Act No. 81 of 17 March 1982 introduced three types of index-linked bond, each of them with a different index-linking. The three types, described separately below, are used in connection with the financing of index-linked loans to 1) owner-occupied dwellings, commercial and agricultural property (I bonds), 2) owner-occupied dwellings (IE bonds) and 3) subsidized housing (IS bonds).

In addition to these there are index-linked loans to farms (IJ loans), energy utilities (AI loans) and the financing of ship construction (SI loans).

All index-linked loans are cash loans and have deferred repayment for one coupon period, i.e. no installments are payable by the debtor at the first coupon due date. With a single exception, the index linked loans also follow the serial principle, but as is described below only the I loans are pure serial loans in real terms. AI loans for energy purposes are based on the annuity principle.

I bonds

In respect of I bonds the same index (the net consumer-price index) is used to adjust the debtor side as well as the creditor side, and thus these are pure serial loans. New index factors will not affect the cash flows in respect of the I loans, i.e. the real cash flow seen in relation to the adjustment index remains unchanged.

The I bond repayment is calculated on the basis of serial loans on the bond side. Interest and installment is calculated as a fixed percentage of the remaining debt (creditor interest) plus a fixed percentage of the principal (installments, drawing amounts).

IE bonds

Contrary to the I bonds the IE bonds use different adjustment principles for the debtor side and the creditor side, respectively. The creditor side is always adjusted on the basis of the development of the net consumer-price index, while the debtor side is adjusted on the basis of the development of the net consumer-price index or the index of average earnings in the private sector, total¹. The debtor side is adjusted on the basis of that of the above-mentioned indices which has increased the least during the reference period applied. The idea is to ensure that, coupon payment period by coupon payment period, the debtor's repayments do not increase more than the wages, and consequently it is called the real wage clause.

Please note that if the real wage clause is put into action this is not compensated for by an extra adjustment in a future coupon payment period, even if the index of average earnings increases more than the net consumer-price index in a subsequent coupon period. If the clause is put into action this will therefore have an effect on the entire remaining life of the loan, which will gener-

¹ Used as from the index factor at 31 December 1998. Before that time the index of hourly rates for the labour in the main industries was used.

ally be rescheduled each time this real wage clause is put into action as the creditor's installments will be deferred.

This is due to the fact that the installments to the creditor (the repayment amount) is calculated residually as the difference between the debtor's total debt service (interest and installments) and interest to the creditor. If the real wage clause is put into action this will mean that the debtor's debt service (interest and installments) will be less than the interest and installments on an ordinary index-linked serial loan in this and all future coupon periods.

However, the life of the loan will never exceed the fixed maximum life of 25½ years. The debtor shall repay any unpaid debts at this time, and all outstanding bonds will thus be redeemed in this coupon period.

All things being equal, the real yield will drop if the real wage clause is put into action. Consideration will be given to this in connection with the price formation, i.e. the investor assesses the risk of the real wage clause being put into action during the entire remaining life of the bond series. Thus, the price of IE bonds must be assumed to be generally lower than the price of the corresponding I bonds.

Even if the real wage clause is not put into action there will be some unpaid debts at the expiry of the last coupon period, cf. below. These debts shall also be repaid when the loan matures.

In contrast to I loans, the repayment of IE loans on the debtor side is calculated on the basis of the cash loan principal. The repayment percentage consists of a 2 per cent repayment amount (in respect of 25½-year loans, as no installments are payable on the first coupon due date), which is fixed throughout the life of the loan and a cash loan percentage which is reduced linearly on every coupon due date in proportion to the number of passed coupon due dates (one fiftieth (1/50) in each coupon period, i.e. ten fiftieths (10/50) after 11 coupon due dates; no installments are payable in the first coupon period, and consequently interest payments in the first and second coupon period are identical). The declining repayment percentage calculated in this way does not show the breakdown by interest and installments to the creditor. Then the repayment is broken down by interest and installments on the creditor side. Firstly, interest to the creditor is calculated on the basis of the remaining bond debt and the coupon rate, whereupon the installments are fixed residually. On the

debtor side the installments are arrived at by multiplying the creditor installment by the price on the date when the loan was raised (internal settlement price), and then the debtor interest rate is determined residually as the debtor's total debt service less the calculated debtor installment.

This method has the result that the loan will not be fully amortized within the maximum life of the loan if the borrowing price is not 100. The reason for this is that the cash loan interest is fixed on the basis of an assumption of serial loan terms on the creditor side (the bond side), while the IE model as such is actually based on serial loan terms on the debtor side (cash loan side), cf. the fixing of the repayment percentage, as described above.

When the yield is calculated in respect of IE bonds, more specific assumptions must be made:

Assuming that the real wage clause is not put into action during the yet unknown price and wage periods, the calculation of real-interest yield becomes independent of the development of the two adjustment indices, and consequently it is unnecessary to project the future development of the two indices. If the real wage clause has been, is or will be put into action on the basis of the price and pay indices available, the effect hereof is allowed for in the calculation of the cash flows on which the yield calculation is based.

As a consequence of this assumption the real-interest yield calculated by NOC in respect of IE bonds must be regarded as an estimate a little on the high side of the actual real-interest yield.

As stated the IE loans are cash loans, and consequently the cash loan interest rate (debtor rate of interest) must be calculated before the calculation of the yield. The cash loan interest rate is calculated on the basis of the yield calculation price. The cash loan interest rate is calculated for the remaining part of the opening period on the basis of the average price on the day of listing, whereas for the part of the opening period which has passed in each coupon payment period a simple av-

erage of the daily average prices of the coupon payment period is used.

As is the case with I bonds, the real-interest yield calculated like this is real compared with the net consumer-price index, which is always used to adjust the creditor side.

Calculation of adjustment factor on IE bonds

As a consequence of the cash loan interest rate's influence on the cash flow, this will be changeable during the tap period in connection with price changes. The price may thus affect the payments from the debtors to the creditors.

Hereby the calculations of adjustment factors showing the changes in the real-interest yield per annum as a consequence of a one point price change are also affected. However, since the calculations of the adjustment factors will be much more complicated and at the same time the effect will be limited, it has been decided not to include the effect of a change in the cash flow as a conse-

quence of the price change in NOC's calculations of adjustment factors for IE bonds.

IS bonds

In respect of IS bonds, which are used to finance loans for subsidized housing construction, different adjustment principles are also used on the debtor and creditor side, respectively. On the creditor side the net consumer-price index is always used as is the case with the other index-linked bonds, whereas the debtor side, as is the case with IE loans, is adjusted in accordance with the development of the net consumer-price index or the index of average earnings in the entire private sector in such a way that the installment (repayment) will not increase more than this index of average earnings - the real wage clause.

In addition to this, the debtor repayment is only adjusted by a maximum of three fourths (3/4) of the increase in the relevant index. The adjustment of the repayment on IS loans appears from the below chart:

Change in net consumer-price index	Change in the index of average earnings in the private sector	Resulting adjustment of debtor repayment
Increase or no change	Increase or no change	The preceding coupon payment increases by 0 or 3/4 of the increase in the index which has increased the least
Drop	Increase or no change	No adjustment
Immaterial	Drop	The payment drops compared with the preceding coupon period by the entire drop in the pay index

In respect of IS loans no installments are payable in the first coupon period. In the second coupon period the repayment percentage has been fixed at 2.4 per cent of the indexed cash loan principal divided by the settlement price. If the loans were pure serial loans (or if the rate of inflation were zero throughout the entire life of a loan), such loans would consequently be repaid within 21 or 22 years, as amortization has been deferred for one coupon period. In the case of a positive price trend, the life of the loan will be extended as the repayment is only adjusted by three fourths (3/4) of the increase in prices, while the remaining debt on the bond side is adjusted in full. Prior to 1990 the maximum life was fixed at 35½ years, after which period any remaining debt should be repaid by the debtor.

Act No. 841 of 20 December 1989 on mortgage banks (the Danish Mortgage Credit Act) changed the maximum life from 35½ years to 50½ years, and the repayment percentage for the first repayment period was consequently changed from 2.4 per cent to 1.4 per cent. The minimum life, which is obtained in the case of zero-inflation, is thus 35 or 36 years.

The debtor's payment is determined as the sum of the installment and interest calculated as the creditor rate (coupon) multiplied by the adjusted remaining bond debt. The debtor's installment is equal to the above-mentioned installment multiplied by the original settling price, and the residual value of the debtor's interest payment is determined by deducting the debtor installment thus calculated from the payment.

Cash flows to be used in connection with the calculation of the yield can only be calculated if the expected development of prices and wages throughout the entire life of the series is projected. This is due to the different adjustment principles on the debtor side and the creditor side. As a consequence of the adjustment of the debtor's installments shown in the chart, typically involving three fourths (3/4) of the increase in the price or pay index, it is necessary to make these projections even if the real wage clause is not put into action.

The yield on IS bonds thus depends on the actual development of prices. Calculations have shown that an almost linear relation exists between real yield and the rate of price increases. Thus, the real yield drops by approximately 0.03 points when the rate of price increases jumps by 1 percentage point.

In its calculations NOC has projected a zero-price development in all unknown future coupon periods: The zero-inflation assumption. However, NOC naturally adjusts the cash flows when new price and pay indices are available, and thus the known price development is taken into account. This means that in connection with the calculation of the index factor, the cash flows in respect of the IS bonds are also updated.

As is the case with the other index-linked bonds, the yields are in real terms in relation to the net consumer-price index.

Agricultural loans (IJ loans)

Like I, IE and IS loans, agricultural loans are index linked loans, and the bonds used to finance the loans are also indexed on the basis of the net consumer price index. The loans may exclusively be granted to farms, and the loans are constructed as cash loans with serial loan terms on the cash loan side. Up to December 1989 four versions of the agricultural loan existed:

1. Serial loan with installment subsidies
2. Serial loan without installment subsidies
3. Bullet loan with installment subsidies
4. Bullet loan without installment subsidies

Following the passage of the Danish Mortgage Credit Bill on 20 December 1989, agricultural loans with installment subsidies can no longer be obtained. Since these loans will continue to be listed on the CSE for a number of years to come, the effect of installment subsidies is included in the description.

However, it is of importance to the calculation of the yield that the agricultural loans are financed with the same type of bond, irrespective of the arrangement of the underlying agricultural loan (distribution among the 4 types stated above). Consequently, some assumptions must be made in addition to the usual ones in respect of index-linked loans:

- a. the distribution among bullet loans and serial loans.
- b. the distribution among serial loans with and without installment subsidies.
- c. the distribution among bullet loans with and without installment subsidies.
- d. the future development of the net consumer-price index as it affects the installment subsidy, which in its turn affects the distribution of the amounts available for the drawing of bonds.
- e. rates resulting from transfer of ownership etc.

The reason for including the distribution among loans with and without installment subsidies, respectively, is that the installment subsidies mean that 30 per cent of the indexation of the remaining debt is paid immediately by the government and is thus included in the drawing amount. In respect of loans without installment subsidies only a part of the indexation equal to the usual repayment percentage will be repaid and thus be included in the drawing amount; and for the first many years it will be somewhat below 30 per cent. All things being equal, payment of installment subsidies means that the loans are redeemed sooner and consequently that the drawing amounts are larger on these coupon due dates.

In the yield calculation system of NOC the following assumptions are made:

1. As is the case with the other types of index-linked bonds, inflation is assumed to be zero in unknown future coupon periods.
2. In respect of opening periods where the distribution among bullet loans and serial loans is still unknown, it is assumed that the loans are granted as 50 per cent bullet loans and 50 per cent serial loans.

3. In respect of opening periods where the distribution among loans with and without installment subsidies, respectively, is unknown, it is assumed that all loans (bullet as well as serial loans) are granted without installment subsidies.

In respect of opening periods where these factors are known, the factors are included in the calculation of the cash flow and thus the yield.

NOC shall be notified of the distribution among loans after each coupon due date in the opening periods. These announcements are included in the projection of synthetic cash flows as NOC receives them.

Agricultural loans are granted as 10½-year loans and 30½-year loans, respectively. The principles of the loans differ according to whether the life is of 10½ years or 30½ years.

The 10½-year loans are unique in that the serial loan part is repaid as if it were a 30½-year loan, but in such a way that the remaining debt is repaid after 10½ years at the same time as the bullet loan is redeemed.

Index-linked ship credit loans (SI loans)

SI bonds for the purpose of funding loans for the construction of vessels were introduced in connection with the so-called “ship package” in 1986. It carries a government inflation guarantee, which means that the debtor’s total nominal interest can be of maximum 5.5 per cent per annum.

The index adjustment is according to the net consumer-price index, and the inflation guarantee means that the debtor’s unpaid debts in respect of loans financed by means of SI bonds with 2.5 per cent coupons may be adjusted by not more than 3 per cent, and the debtor’s unpaid debts in respect of loans financed by means of SI bonds with 4 per cent coupons may be adjusted by not more than 1.5 per cent per annum.

However, the creditors always get a full inflationary compensation on the basis of the net consumer-price index as the government will pay any adjustment beyond these maximum adjustments for the debtors. Seen from the creditor’s point of view the SI bonds thus follow the same principles as the I bonds as both the debtor side and the creditor side are in reality adjusted in full on the basis of the net consumer-price index, only part of the

debtor’s payment may be paid by the government as subsidies. However, the loan conditions differ as the life of an SI loan is 14 years and the grace period (deferred repayment period) is 4 years.

Index-linked annuity loans (AI loans)

In 1986 a new method of funding renewable energy facilities was introduced: the issue of index-linked annuity bonds. The loans are thus redeemed in accordance with the annuity principle. The debtor as well as the creditor side are adjusted on the basis of the development of the net consumer-price index, which corresponds to the principle applicable to the I loans.

In the yield calculation system of NOC these AI bonds are entered as ordinary annuity bonds, only the coupon should be deemed a real-term coupon, and the cash flow should be deemed to be the real cash flow.

3.3 Treasury bills

Treasury bills are short-term instruments of debt (3, 6, 9 and 12 months) with no coupons, so-called zero-coupon securities. This means that the capital gain makes up the total return on the investment.

Furthermore, a zero-coupon security is characterized by having only one repayment date.

Treasury bills are bullet loans, and the yield is calculated according to the general rules of calculation of yields on nominal bullet loans, as far as the calculation of yield according to the bond market convention is concerned.

Treasury bills differ from bullet bonds in that in addition to the yield calculation according to the bond market convention, a yield is also calculated according to the money market convention. The essential differences between the two methods are:

1. According to the bond market convention the effect of compound interest is included. The money market convention does not take this effect into account as a linear calculation of the yield per annum is used.
2. The bond market convention uses the actual/actual interest day convention when calculating the number of interest days, while the money market convention uses the ac-

tual/360 day convention in the calculation of interest days.

3.4 Other loans and bonds issued in foreign currencies

Loans with partial amortization

On ordinary loans the debtor pays interest as well as the full installment in the first coupon period. According to the principle of partial amortization only a proportionate part (depending on the date the loan was paid out) of the installment is paid in

the first coupon period. This fact is allowed for in connection with the projection of the cash flow.

Foreign bonds

In respect of foreign bonds, yield calculation as a rule is made on the basis of the actual facts described in the respective prospectuses. This means that the yield will be calculated on the basis of e.g. a number of settlement days which does not always correspond to the current Danish practice. This also applies to the period during which the bonds are traded ex coupon.

4. Calculation of yield on bonds

4.1 Calculation of pre-tax yield

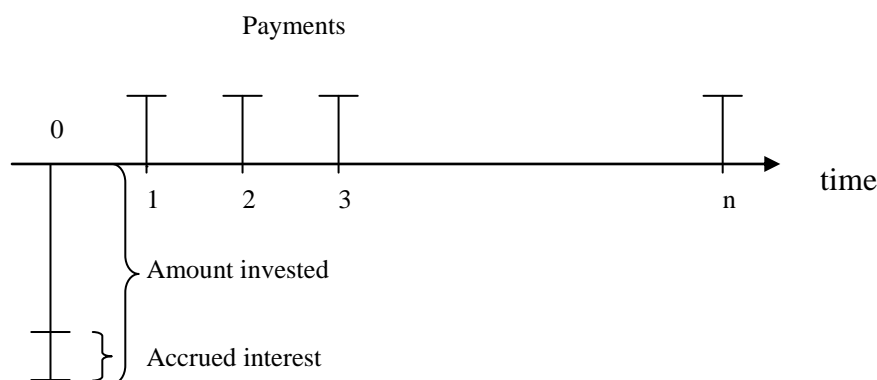
The same formula for the calculation of yield on bonds applies to the various existing types of loans. The difference between the types of loan will be reflected in the cash flow.

The yield is determined by discounting the value of the cash flow, so that it equals the amount ac-

tually invested, i.e. price inclusive of accrued interest (positive or negative) depending on whether the transaction is cum or ex coupon. The cash flow will be discounted to the settlement date.

Figure 4.1 shows an example of an annuity loan with n coupon periods:

Figure 4.1: Cash flow of an annuity loan



In the above example the accrued interest is greater than zero, i.e. the bond is traded cum coupon.

All payments are at first discounted to coupon due date 1, whereupon the payments are discounted with the part of the present coupon period which remains from the settlement date t to the 1st coupon period. The part is calculated as the period remaining from the point of time t (the settlement date) to the 1st coupon period divided by a whole coupon period, which corresponds to the period from point of time 0 to point of time 1 in figure 4.1.

In connection with the calculation of yields the intervals between the coupon due dates are assumed to be of equal length. This also means that interest and installments are assumed to become payable on the coupon due date, irrespective of whether the coupon due date does not fall on a trading day.

The real-interest yield calculation for index-linked bonds follows the same principle as nominal

bonds, i.e. the real cash flow is discounted to the time of settlement.

The calculated yield per coupon due date is immediately converted into annual yield by including information on the number of coupon due dates of a given series per annum.

4.2 Calculation of yield on Treasury bills

In respect of Treasury bills, which are zero-coupon securities with only one repayment date, a bond market yield as well as a money market yield are calculated, cf. section 3.3.

4.3 Calculation of post-tax yield

In pursuance of Danish tax legislation private individuals shall pay tax on interest earned and capital gains. Companies shall also pay taxes on interest as well as capital gains. The capital income for both private individuals and companies are taxed at the current tax rate.

Therefore the tax on both interests and capital gains/loss' is included in the yield after tax calculation.

Pay-as-you-earn tax is used in the calculation, which means that tax on income from coupons is deemed paid on the coupon due date in question, and tax on accrued interest is paid on the settlement date.

Adjustments in respect of tax on interest are made directly on the cash flow, i.e. before the actual calculation. The tax on the interest is deducted from the cash flow, whereupon the post-tax yield is calculated by means of the new cash flow which is compared with the amount invested, and where

tax has also been deducted from the accrued interest. This corresponds to figure 4.1 being construed as payments from which tax on interest has been deducted, and accrued interest is construed as interest on deferred payments after tax withheld, i.e. the net amount which the buyer receives from or pays to the seller.

Tax on capital gains is also implemented directly on the cash flow, where tax on the capital gain is deducted from the individual installments. This means that an amount corresponding to the tax rate multiplied by the share of the installment that corresponds to the capital gain is deducted from each payment.

5. Calculation of other derived yield measures etc.

5.1 Duration

The duration expresses the average remaining life in years of a bond, i.e. the period of time for which the investor must on average keep his bond, before the investment has been repaid; the payments received correspond to the amount invested. NOC uses the concept of duration introduced by Macaulay (1938), which in connection with the determination of the average remaining life takes the timing of the installments into consideration, i.e. the question of whether it is a serial loan, an annuity loan or a bullet loan is included in the determination of the life.

The duration is calculated on the basis of the payment sequence of the bond by weighting the life of each payment against the present value of the individual payments compared to the market value (the amount invested). The result is an expression of the average remaining life of a bond.

In addition to being an expression of the average remaining life, the duration may also be construed as an expression of the risk of declining prices in respect of a bond, where the duration may be defined as the approximate percentage change in the price of a bond when the yield is changed by 1 per cent (the elasticity interpretation).

5.2 Adjustment factor

The adjustment factor states the effect that an increase in price of 1 percentage point has on the yield.

The adjustment factor is calculated on the basis of the connection between the amount invested and the yield. In NOC yield calculation system the adjustment factor is determined as the difference between the yield of the day and the yield after the price has risen by 1 percentage point. Thus, the adjustment factor shows how much the yield will drop if a price rises by one percentage point.

5.3 Revaluation factors

Daily revaluation factors

The daily revaluation factor, which is calculated each trading day and published in the electronic information system is defined as the price increase resulting from a shortening of life of one day provided that the yield remains unchanged.

In NOC's yield calculation system adjustments are made in respect of the change of the accrued interest in connection with this calculation, so that the true effect of the price fluctuation is seen.

6. Calculation of average yield by groups

A number of average yields are calculated for publication on the NASDAQ OMX website and for the electronic information system, partly for bonds in total and partly by groups.

Only DKK bonds that uses the Danish market standard for yield calculation – actual/actual- is used in the calculation of average yields.

Please note that all bonds from group III (see the Official List for grouping) and treasury bills are left out of the calculation of averages. *Series with a remaining life of 3 months or less* are also excluded from the calculation of averages.

The average yield is calculated before tax as well as after tax.

The following overall groups have been defined:

1. Danish government bonds (“government”), Danmarks Fiskeribank (“fisheries”) and Færøernes Realkreditinstitut (“the Faroes”)
2. Standard mortgage
3. Special institutions
4. 1st and 2nd mortgage credit
5. Total

Each of these groups is divided into sub-groups based on years to maturity:

1. equal to or less than 3
2. above 3, equal to or less than 5
3. above 5, equal to or less than 15
4. above 15, equal to or less than 25
5. above 25, equal to or less than 35
6. above 35
7. total.

It applies to each of the sub-groups that at least one of the following criteria must be met:

- i. The group shall include at least 5 series.
- ii. The group’s total nominal volume in circulation shall amount to at least DKK 500 million.

Any securities which are not represented in a sub-group will, however, always be included in row totals. If a sub-group is not represented as a consequence of the above, this is indicated by “0” in the field. This also applies if there are no securities at all in a field (sub-group).

The average yield is published on NOC’s website: <http://www.nasdaqomxnordic.com/obligationer/danmark/rentegennemsnit/?languageId=1>

The individual series which are part of groups and sub-groups in the calculation of averages are weighted with the market value of the volume in circulation in the series in question.

7. Calculation of index factors

Index factors

All index factors are calculated according to the Danish Mortgage Credit Act No. 898 of 4 September 2008 of the Danish Ministry of Economic Affairs. The three types of index factor for mortgage credit loans and the 2 types of shipping index are all calculated approximately one year ahead of the coupon period to which they apply.

The creditor index factor - index factor 3

This index factor, which is used to adjust the creditor's outstanding account, is **always** calculated on the basis of the development of the net consumer-price index. The development throughout 2 periods is studied as the index-linked loans have 2 coupon due dates per annum. The periods run from November to May and from May to November as the creditor due dates of the index-linked loans are 30 June and 31 December.

Index factor for owner-occupied dwellings - IE loans - index factor 1

This index factor is used to adjust the debtor's principal and thus the debtor's repayments on IE loans. Therefore, this factor is only of indirect importance to the creditor in that it helps decide the distribution of the creditor's payments over time.

The factor is calculated on the basis of the development of the net consumer-price index or the index of average earnings in the entire private sector, depending on which of these indices had the smaller increase in the period in question. The periods are completely identical with those stated above in respect of the creditor index factor.

Index factor for subsidized housing - IS loans - index factor 2

The index factor used to adjust the repayments on index-linked loans to subsidized housing is referred to as index factor 2 and, as is the case with index factor 1 for owner-occupied dwellings, it also applies to the debtor side. Otherwise, the same rules apply to adjustment dates and reference periods.

As is the case with index factor 1, this adjustment is also based on the development of the one of the

two indices with the smaller increase. However, please note that the adjustment is only made by three fourths (3/4) of the development of the relevant index where an increase is involved. If the pay index drops, compared with the previous coupon period the installment will fall by the total drop in the pay index.

Index factor of the day/index adjustment factor of the day

With the index factors calculated above the adjusted value at the coupon due dates is known. In connection with settlement etc. it is, however, necessary to know the index factor of the day (index factor 3 - the creditor side).

For this purpose a so-called index adjustment factor is calculated, which is a daily revaluation factor. The factor is calculated on the assumption that the index factor is revalued linearly between two coupon periods.

Shipping index - 1½ per cent and 3 per cent

In 1986 index-linked loans carrying a government inflation guarantee were introduced in connection with the passage of the "ship package". The loans are financed through bonds issued by Danmarks Skibskreditfond (the Ship Credit Fund of Denmark). In this connection NOC calculates the so-called **shipping indices**. The inflation guarantee means that the index adjustment will not exceed 1.5 and 3 per cent, respectively, per annum on the debtor side, while, as stated in section 3.2, the creditor side (the remaining bond debt) is always adjusted on the basis of the development of the net consumer-price index (index factor 3).

This corresponds to the following maximum adjustment factors per coupon due date:

0,7472
1,4889

If the increase of the net consumer-price index is less than these maximum adjustment factors, the adjustment is based on the net consumer-price index.

Reference periods and times of adjustment are identical with those of the other index-linked loans, cf. above.

Technical appendix

1. Introduction

In this appendix some of the formulas which are used in the calculation of yields, duration, adjustment factors etc. at NASDAQ OMX Copenhagen A/S are described.

2. General assumptions

Cash flows - projection

The cash flow of a given bond series is the interest and installment amounts calculated for each remaining coupon due date in respect of all the debtors of the series collectively, i.e. the amounts which, during the remaining life of the series, go to the creditors.

The cash flow is calculated on the basis of the drawing chances of the bond series in question. The drawing chance is calculated as the drawing amount divided by the total unpaid debts of the series at the coupon due date in question.

The general formula for calculating the drawing chance of coupon payment period i is:

$$u_i = \frac{a_i}{RG_i} \quad (1)$$

where:

- u_i : the drawing chance of coupon payment period i
- a_i : the installment of coupon payment period i
- RG_i : the unpaid debts of coupon payment period i

Formula 1 shows that the drawing chance is defined as the ratio of the total amount which goes to installments in the coupon period in question to the total unpaid debts of the bond series.

The amount invested - accrued interest

The yield is calculated on the basis of the amount actually invested, which is made up of the market value to which accrued interest (positive or negative) has been added. The formula for calculating the amount invested depends on whether the bond is traded cum or ex coupon.

Cum coupon:

$$I = k + \frac{x}{nt} * \frac{r}{tpa}; \quad x = 1, \dots, (nt - P) \quad (2)$$

Ex coupon:

$$I = k - \frac{(nt - x)}{nt} * \frac{r}{tpa}; \quad x = \lfloor (nt - P) + 1 \rfloor, \dots, nt \quad (3)$$

where:

- I: the amount invested.
- k: the turnover-weighted transaction price
- x: the number of interest days which have passed as from the previous coupon due date up to the settlement date.
- nt: the number of days of the coupon payment period in question.
- tpa: the number of coupon due dates per annum.
- r: the coupon rate; r/tpa thus becomes the coupon rate per coupon due date.
- P: the number of days before the coupon due date when the series is traded ex coupon (typically 0 days for Danish bonds).

Accrued interest in respect of index-linked bonds is calculated similarly.

3. Assumptions in respect of specific loans

Floating-rate bonds

The annual coupon rate is calculated according to a reference rate average in a reference period, using the following formula:

$$r = [({}^{tpa}\sqrt{1 + r_g} - 1) * tpa] \quad (4)$$

where:

- r: the annual coupon rate, calculated to one decimal place.
- r_g: the simple average of the reference rates in the reference period, calculated to two decimal places.

The annual coupon rate is calculated in consideration of the fact that the average rate is an average of yields which takes the principle of compound interest into account. Thus, in connection with the calculation of the annual coupon rate it is necessary to extract the tpath root of the average rate.

4. Calculation of yield on bonds

Calculation of pre-tax yield

When the cash flow has been projected, the yield per coupon due date is calculated using the following formula:

$$k + ren = \sum_{i=1}^n Y_i * (1 + et)^{-(andel+i-1)} \quad (5)$$

Where:

- ren: the accrued interest per settlement date.
- y_i: the payment period i.
- et: the yield per coupon due date.
- andel: the part of the present coupon payment period which remains from the settlement date to the next coupon payment period.

The yield per annum is equal to:

$$e = (1 + et)^m - 1 \quad (6)$$

Where:

e: the yield per annum.

Treasury bills

In respect of Treasury bills, a yield is calculated according to the money market convention as well as according to the bond market convention.

Money market yield:

$$e = \frac{(AK + r) / (k - ren) - 1}{andel^p} \quad (7)$$

Where:

AK: the repayment price/redemption price.

andel^p: the part of the repayment period which remains.

The part is calculated as the remaining life in number of actual days divided by 360.

Yield according to the bond market convention:

$$e = \exp\left(\frac{\ln(AK/K)}{andel^p}\right) - 1 \quad (8)$$

Where:

andel^o: the part of the repayment period which remains, i.e. the number of remaining days divided by number of days of the year (365 or 366, if there is an intercalary day in the period).

Calculation of post-tax yield

Adjustments in respect of tax in the calculation of yield are made directly on the cash flow. The tax on the interest is deducted from the cash flow, whereupon the post-tax yield can be calculated as in formula (5), slightly rewritten:

$$k + (ren * (1 - skt)) = \sum_{i=1}^n Y_i^* * (1 + et)^{(andel+i-1)} \quad (9)$$

Where:

skt: the tax rate on interest.

Y^{*}: the payment after tax.

The yield per annum is then calculated as in formula (6).

Adjustments in respect of tax on capital gains are also implemented directly on the cash flow, where the remaining installments are taxed according to the share which corresponds to the capital gain. Formula (10) shows the principle of yield calculation after tax on capital gains:

$$Y^{**} = rente + afdrag - (afdrag * ((AK - k) * skt^k)) - rente * skt \quad (10)$$

Where:

Y^{**} : the payment after tax on capital gains and tax on interest.

skt^k : the tax rate on capital gains.

$$k + (ren * (1 - skt)) = \sum_{i=1}^n Y_i^{**} * (1 + et)^{(andel+i-1)} \quad (11)$$

5. Calculation of other derived yield measures etc.

Duration

The duration of a fixed-rate claim is calculated using the following formula:

$$V_t = \frac{\sum_{i=1}^n (t - 1 + andel) * y_t * (1 + et)^{-(t-1+andel)}}{k + ren} \quad (12)$$

Where:

V_t : the duration in number of coupon payment periods at time t.

The duration in number of years is calculated as:

$$V_{\hat{a}r} = V_t / tpa \quad (13)$$

Adjustment factor

The adjustment factor is calculated as the change in yield which corresponds to a change in price of 1 percentage point.

In respect of **prices up to and including 99**, the adjustment factor is calculated as:

$$Korr.faktor = e(k) - e(k + 1,0) \quad (14)$$

Where:

$e(k)$: the yield in respect of turnover-weighted transaction price k.

k: the turnover-weighted transaction price.

In the **price range from 99 up to and including 100**, the adjustment factor is calculated as:

$$Korr.faktor = \frac{e(k) - e(k + h)}{h} \quad (15)$$

Where:

$$h = 100 - k$$

In respect of **prices above 100**, the adjustment factor is calculated as:

$$\text{Korr.faktor} = e(k-1,0) - e(k)$$

(16)