

Change in the methodology for calculating the interest rate convergence criterion for the Czech Republic

1. Introduction

The Treaty on European Union lays down four convergence criteria that must be fulfilled by each Member State before it enters the third stage of the Economic and Monetary Union. This document describes a change in the methodology used to calculate the long-term interest rate (LTIR) convergence criterion for the Czech Republic. The change in methodology consists in switching from a calculation using a single benchmark bond (hereinafter the “benchmark method”) to a calculation using a “basket of bonds”. The changeover to the new LTIR calculation method was made possible by the gradual expansion of long-term government bond issues in the Czech Republic. The results of trading in these bonds on the capital market serve as the basis for the LTIR calculation.

The change in the LTIR calculation methodology was discussed with and approved by the relevant unit of the European Central Bank responsible for the LTIR methodology in the EU.

2. LTIR calculation methodology used at the ECB

The bonds used in the LTIR calculation should be issued by the central government, as it is assumed, on the basis of experience, that these are the best collateralised type of bonds. Therefore, their price should be relatively immune to capital market risks.

In general, the following LTIR calculation rules must be adhered to:

- bonds with a residual maturity of close to 10 years can be gradually included in the calculation. This recommendation necessitates the regular issue of comparable long-term bonds;
- the bonds included in the calculation should be sufficiently liquid;
- special-feature government bonds (zero-coupon bonds, embedded option bonds, etc.) are to be omitted from the calculation
- the LTIR is not adjusted for the coupon and should be gross of tax;
- any replacements of the benchmark bond should minimise residual maturity drift. The maximum tolerated drift in the residual maturity is one year. When such changes are made, the residual maturity should stay between 9.5 and 10.5 years.
- the yield to maturity is calculated according to the recommendations of the International Securities Market Association (ISMA), also referred to as ISMA 6.3 or Yield-to-Maturity (YTM):

$$P = \sum_{i=1}^n CF_i * V^{L_i}$$

where:

- P ... gross price (i.e. clean price plus accrued interest),
- n ... number of future cash flows,
- CF_i ... i-th cash flow (can be variable),
- L_i ... time in years to the i-th cash flow, and
- V ... annualised discounting factor ($V = 1/(1+y)$, where y is the annualised yield).

The following approaches are used to calculate the LTIR under ECB methodology:

- benchmark bond approach – a representative liquid bond is selected for each period, and the yield on that bond is the LTIR;
- basket of bonds approach – a *basket of bonds* consisting of selected liquid bonds with a suitable range of residual maturities is compiled for each period. If this method is used, the ECB's methodological guidelines recommend that the average residual maturity of the basket of bonds should be calculated as a simple arithmetic average of the residual maturities of the bonds included in the basket in order to determine the deviation from the reference residual maturity of 10 years. Similarly, the average yield on the basket of bonds is calculated as a simple arithmetic average of the yields on all bonds included in the basket.

The quality of the LTIR data is continuously monitored by the ECB.

3. The original LTIR calculation method used in the Czech Republic and its shortcomings

The benchmark bond method was introduced in the Czech Republic in 2000. The LTIR was calculated for each period based on the yield on the most recent known government bond with an original maturity of 10 years. However, practice showed that this method was no longer optimal, owing to gradual changes on the government bond market in the Czech Republic. The LTIR calculation, which at that time depended on the government's strategy for the issuance of 10-year government bonds, ceased to be appropriate. This was due chiefly to a declining frequency of issuance of such bonds, coupled with an uncertain outlook as regards the regularity and frequency of future issues. This gave rise to the following shortcomings in the original approach:

- Non-compliance with the required residual maturity band of 9.5–10.5 years: The almost two-year cycles between issues of 10-year koruna government bonds caused the residual maturity used in the LTIR calculation to range between 8 years (or even less) and 10 years.
- Large drift in the time series of residual maturities and yields: Sizeable drift occurred when one benchmark bond was replaced by another newly issued 10-year bond.

In 2007, substantial divergence from the LTIR methodology recommended by the ECB started to occur, as the residual maturity of the benchmark bond fell below 8 years shortly before the most recent issue of the 10-year bond. Therefore, the ECB asked the CNB to submit a proposal for a revision of the LTIR calculation method. After conducting an analysis, the CNB proposed the use of the basket of

bonds approach for the LTIR calculation in the Czech Republic. This new method was discussed with and approved by representatives of the relevant unit of the ECB.

4. The new LTIR calculation method used in the Czech Republic

The change in methodology consisted in the introduction of an LTIR calculation based on a basket of bonds. This basket contains government bonds with original maturities exceeding or equal to 10 years, which are classified as benchmark bonds. The criteria for such a rating are analogous to those used by the Ministry of Finance together with the Czech Bond Dealers Club and the CNB to define benchmark issues of medium-term and long-term government bonds. The bond must: (i) be issued in CZK, (ii) have been sold in sufficient volumes in all tranches (net of repurchases by the Ministry of Finance) as of the basket determination date, (iii) have an original maturity of 10 to 30 years, and (iv) be traded in the Prague Stock Exchange's main market. This rating ensures that such bonds also fulfil the liquidity condition for inclusion in the basket of bonds.

Manner of inclusion of bonds in the basket

In the first step, a “basic set” containing internally classified benchmark bonds is specified each working day. These bonds have residual maturities ranging from 8 to 12 years.¹ In the next step, a combination of bonds is selected from this set whose average residual maturity is as close to 10 years as possible.² In line with ECB methodology, this “best” combination of bonds is labelled as the basket of bonds. The average yield is then calculated as a simple arithmetic average of the yields³ on all bonds included in the basket. This represents the LTIR.

Improvement compared to the original LTIR calculation methodology

The analysis confirmed that the switch to the basket of bonds approach will ensure compliance the LTIR calculation recommendations. Above all, the recommended range of 9.5–10.5 years will be maintained and the maturity drift in the event of changes in the basket and the related drift in the yield time series will be reduced. The new approach is less dependent on the issuance strategy of the central government.

¹ This range for the inclusion of government bonds in the basic set was calculated on the basis of the issue frequency of the first tranches of government bonds and was discussed with the ECB. Generally speaking – under the government's current strategy – government bonds with an original maturity of 10 years are issued roughly every two years. Government bonds with original maturity of 15 years are also issued every two years, but always six months after the 10-year government bond is issued. We also performed tests with other ranges. With a narrower range, the basic set very often consisted of only one bond (meaning that the new LTIR calculation would not have differed from the original one). When a broader range was used, the basic set included bonds with very extreme residual maturities.

² Hence, if the basic set contains three bonds A, B and C, we obtain a total of seven possible combinations with the following basket compositions: A, B, C, A+B, A+C, B+C, A+B+C. The residual maturity is calculated for each such basket (the average residual maturity is calculated as a simple arithmetic average of the residual maturities for baskets containing more than one bond).

³ The bond yield calculation is based on the mid of the average reference prices (quotations) for the purchase and sale of bonds. The source for the calculation is daily data from the Prague Stock Exchange's official price list.

5. Revision and publication of LTIR time series

A retrospective data revision had to be performed together with the change in methodology. An analysis revealed that the original (benchmark) approach had satisfied the criteria until the end of 2003. From 2004 onwards, however, the new, more exact approach (basket of bonds) started to show drift in residual maturity and yield by comparison with the benchmark method. Therefore, the start of 2004 was selected as the cut-off point for the revision of the LTIR series.

The monthly LTIR time series was revised as of the date of publication of the first LTIR calculation under the new approach for April 2008, i.e. on 7 May 2008. The updated LTIR time series, together with an updated methodological sheet, was published in the Financial market statistics section of the ARAD database (*Capital market >> Government bond yields >> Long-term interest rates for assessing convergence (%) >> 10-year maturity Treasury bond yield (Maastricht criterion)*).

The monthly LTIR time series calculated using the original benchmark approach corresponds to the 10-year government bond yield time series (*Time series database – ARAD >> Financial market statistics >> Capital market >> Government bond yields >> Government bond yields (monthly averages) (%) >> 10-year maturity Treasury bond yield*).