Methodology for pricing Hungarian Government fixed coupon bonds (Actual/Actual - ISMA)

$$P = \sum_{i: d_i > d_S} \frac{F_i}{(1 + T_p)^{p_{iS} + \frac{nbc}{w}}}$$

where

P = Gross price,
d_i = cash-flow dates of the security (i=1,...,n),
d_S = date of settlement,
F_i = cash-flows of the security (i=1,…,n),

For calculation of F_1

Let

d_0 = issue date,
d_t = technical (=fictional) cash-flow date,

$d_t = d_1 - l$, where l is the length of a coupon period in months,

d_{t0} = technical (=fictional) cash-flow date,

$d_{t0} = d_1 - 2l$, where l is the length of a coupon period in months,

If we have $d_t < d_0$ (short first coupon), then

$$F_1 = \frac{g}{f} * \frac{d_1 - d_0}{d_1 - d_t},$$

If we have $d_0 < d_t$ (long first coupon), then

$$F_1 = \frac{g}{f} * \left(1 + \frac{d_t - d_0}{d_t - d_{t0}}\right),$$

where

g = annual coupon rate,
f = number of coupon payments a year.

For calculation of F_i for i = 2,…,n

$$F_i = \frac{g}{f} \qquad \text{for } \forall\, i = 2,\ldots,n-1, \text{ and} \qquad (*)$$

$$F_n = \frac{g}{f} + 100, \qquad (*)$$

where

g = annual coupon rate,
f = number of coupon payments a year.
Note that for bonds issued before 01-Mar-2002, paying semi-annual coupons, the semi-annual coupon rates are explicitly specified for each coupon period in their Public Offering according to the then effective ACT/365 convention.

Such bonds outstanding on 01-Jun-2007 are the following: A090212B99 (ISIN HU0000402177), A110212A00 (ISIN HU0000401922), and A121213A92 (ISIN HU0000400692).

Hence, for the bonds above, instead of (*), the cash-flow in the Public Offering applies.

For calculation of the discount factor

The discount factor is

$$D(S,i) = \frac{1}{(1+T_p)^{p_{Si}+\frac{nbc}{w}}},$$

where
$\mathbf{T_p}$ = periodical yield to maturity,

$T_p = \sqrt[f]{1+T_a} - 1$, where f is the number of coupon payments a year and T_a, is the annual yield to maturity,

$\mathbf{p_{Si}}$ = number of cash-flows between d_S and d_i,
nbc = number of days between the settlement date and the first cash-flow date after the settlement day,

If $d_s < d_t$, then $nbc = d_t - d_S$,

else $nbc = d_1 - d_S$,

w = number of days between the last cash-flow date before the settlement date and the first cash-flow date after the settlement date,

If $d_s < d_t$, then $w = d_t - d_{t0}$,

if $d_t < d_s < d_1$ then $w = d_1 - d_t$,

else $w = d_i - d_{i-1}$, where d_i is the first cash-flow date after the settlement date.

Clean price = Gross price – Accrued interest

For calculation of accrued interest

If the settlement date is before the first cash-flow date, then

if $d_t < d_0$ (short first coupon), then *accrued interest* $= \frac{g}{f} * \frac{d_S - d_0}{d_1 - d_t}$,

if $d_0 < d_t$ (long first coupon), then

if $d_S < d_t$, then *accrued interest* $= \frac{g}{f} * \frac{d_S - d_0}{d_t - d_{t0}}$,

if $d_t < d_s$, then *accrued interest* $= \frac{g}{f} * \left(\frac{d_t - d_0}{d_t - d_{t0}} + \frac{d_S - d_t}{d_1 - d_t} \right)$.

If the settlement date is after the first cash-flow date, then

accrued interest $= \frac{g}{f} * \frac{d_S - d_{i-1}}{d_i - d_{i-1}}$, where d_i is the first cash-flow date after the settlement date. (**)

Note that for bonds issued before 1st March 2002, paying semi-annual coupons, the semi-annual coupon rates are explicitly specified for each coupon period in their Public Offering according to the then effective ACT/365 convention.

Such bonds outstanding on 01-Jun-2007 are the following: A090212B99 (ISIN HU0000402177), A110212A00 (ISIN HU0000401922), and A121213A92 (ISIN HU0000400692).

Hence, for the bonds above, instead of $\frac{g}{f}$ in (**), the coupon rate defined in the Public Offering applies.

Rounding rules

Gross price and accrued interest are rounded to 4 decimal places,

Cash flows has the same precision as for $\frac{g}{f}$, but at least 2 decimal places.

Example: if g=9,25% and f = 2 (semi-annual coupon payment), g/f has 3 decimal places (4,625%) ⇒ F_i must have 3 decimal places. If g = 9 % and f = 2, g/f has 1 decimal place, but F_i has 2 decimal places, because it is the minimum level.

Example 1

Pricing A090812F06 (ISIN HU0000402359) for 01-Jun-2007 settlement date and yield to maturity 7.30% .

We have d_0 = 28/06/2006, d_1 = 12/08/2007, d_2 = 12/08/2007, d_3 = 12/08/2007, g = 6,50%, f = 1, $T_a = T_p$ = 7.30%, and d_S = 01-Jun-2007.

For calculating F_1.
We have d_t = 12/08/2007 – 12 months = 12/08/2006, a long first coupon, and d_{t0} = 12/08/2007 – 2*12 months = 12/08/2006.

Hence, F_1 =

$$\frac{6.50\%}{1} * \left(1 + \frac{12/08/2006 - 28/06/2006}{12/08/2006 - 12/08/2005}\right) =$$

$$= 6.50\% * \left(1 + \frac{45}{365}\right) = 7.3014\%$$

Rounding for 2 decimals gives F_1 = 7.30%

For the discount factors.
We have nbc = 12/08/2007 – 01/06/2007 = 72, and
w = 12/08/2007 – 12/08/2006 = 365.
$p_{S1} = 0$, $p_{S2} = 1$, $p_{S3} = 2$.

Hence, the discount factors are:

$$D(S,1) = \frac{1}{(1+7.30\%)^{72/365}} = 0,986197,$$

$$D(S,2) = \frac{1}{(1+7.30\%)^{1+72/365}} = 0,919103,$$

$$D(S,3) = \frac{1}{(1+7.30\%)^{2+72/365}} = 0,856573$$

Hence, the gross price is: P = 104.3984%, rounded to 4 decimals.

The accrued interest is:

$$\frac{6.50\%}{1} * \left(\frac{12/08/2006 - 28/06/2006}{12/08/2006 - 12/08/2005} + \frac{01/06/2007 - 12/08/2006}{12/08/2007 - 12/08/2006}\right) = 6.0192\%,$$

which gives the clean price of 98.3792%.

Example 2

Calculating accrued interest for A110212A00 (ISIN HU0000401922) the settlement date of 01-Jun-2007.

This bond was issued before 01-Mar-2002 and is paying a semi-annual coupon. Therefore, coupon rates are specified for each coupon period in the Public Offering.

We have d_i = 12/08/2007, d_{i-1} = 12/02/2007, F_i = 3.72% and d_S = 01/06/2007.

Hence, the accrued interest is:

$$3.72\% * \left(\frac{01/06/2007 - 12/02/2007}{12/08/2007 - 12/02/2007} \right) = 2.2402\%.$$