Financial Instruments and Pricing

Fall 2019

Set 2
(Bonds)

1. Consider a 10-year bond with maturity on 29th February 2020. The bond has nominal value of 10 000 EUR and coupon rate of 10%. Coupons are paid annually in the end of February (EOM).
   a) Compute the amount of coupons paid in 2018, 2019 and 2020.
   b) For a transaction done on the 17th October 2019 the clean price was 99,80. Compute accrued interest and dirty price (cash flow) paid on the spot date (D+2).

   Use various day count conventions: 30/360 US, 30E/360, ACT/ACT (ICMA), ACT/365 (Fixed), ACT/360.*

   *Use description of day count conventions from:
   http://en.wikipedia.org/wiki/Day_count_convention

2. Polish State Treasury (ST) issues long-term (> 1 year maturity) bonds. Among the fixed interest rate bonds aimed at institutional investors the most popular ones are 2-year zero-coupon bonds (OK_) and 5-year (PS_), 10-year (DS_), 20-year & 30-year (WS_) bonds with coupon. The nominal value of all these bonds is 1000 PLN. The interest is paid annually using ACT/ACT (ICMA) day count convention. The table below presents prices of some ST bonds from 17th October 2019.*

Name	Maturity	Nominal interest %	Clean Price	Accrued interest	Dirty Price	YTM
PS0420	25/04/2020	1,50	100,19			
OK0720	25/07/2020	-	99,12			
PS0421	25/04/2021	2,00	100,86			
PS0721	25/07/2021	1,75	100,46			
PS0422	25/04/2022	2,25	101,75			

Fill in blank spaces in the table. Remember that transactions are settled on the spot date (D+2).

*Source: BondSpot S.A. (Fixing)

3. For the bonds from exercise 2 compute:

    a. the average lifetime: $$\bar{T} = \frac{\sum_t t \times CF(t)}{\sum_t CF(t)}$$

    b. (Macaulay) duration: $$D = \frac{\sum_t t \times \frac{CF(t)}{(1+y)^t}}{\sum_t \frac{CF(t)}{(1+y)^t}} = \frac{\sum_t t \times \frac{CF(t)}{(1+y)^t}}{P}$$

    c. modified duration: $MD = D/(1+y)$

    Make calculations for the spot date (D+2). Symbols used in the formulae: *CF(t)* – cash flow in time *t* , *y* = YTM, *P* – present value of the bond (dirty price).

4. An investor has bought a 2.5 year bond with nominal value 1000 PLN paying annual interest of 5% (last coupon is paid on maturity, i.e in 2.5 years). Current YTM is 6%. Compute the change of the (dirty) price if:
    a. YTM increases by 0.1%
    b. YTM decreases by 0.1%
    c. YTM increases by 0.5%
    d. YTM decreases by 0.5%

    Make calculations both exactly and using the modified duration approximation (see the Lecture): $\Delta P \approx - MD\ P\ \Delta y$.

5. Consider a simplified model of a bank. Bank has granted loans for 1 billion PLN with (weighted) average modified duration (MD): 1 year. The bank also has a portfolio of bonds worth 1 bln PLN with average MD: 3 years. Bank finances his activity by offering 2 bln PLN deposits with average MD: 1.5 years. Compute the value of 10-year bonds (MD = 10 years) that the bank should sell and buy instead 1-year bonds (MD = 1 year) in order to avoid the risk of small parallel shifts of the yield curve.

6. In the Lecture we showed that Convexity: $C \geq 0$. As a result the profit caused by the decrease in YTM by $\Delta y \geq$ loss caused by the increase in YTM by the same Δy (if all other conditions are equal investors should choose bonds with highest convexity C). Suppose an investor can choose between 2 bonds: bond A has maturity in 4 years and it pays annual coupon of 4%, bond B is zero-coupon and it has 3.75 years to maturity. YTMs of both bonds are equal 9.29%.
    a. compute modified duration (MD) and Convexity (C) for both bonds
    b. check the effect of a decrease/increase of YTM by 5% on prices of the bonds

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Useful Wolfram Mathematica functions:

- FinancialBond[]