
Question 1: Fixed Income Valuation and analysis**(41 points)**

The following answers do not represent the only calculation methods or explanations that could be applied. Please mark everything as correct as long as the definitions, calculations and relationships make sense (please note that the final digit may vary according to the calculation method)

a)

a1)

The spot rate in year one can be derived using the following approach:

$$100.49 = \frac{3.5 + 100}{1 + R_{0,1}} \Rightarrow R_{0,1} = 3.00\%.$$

Similarly $R_{0,2}$ can be calculated using

$$100.94 = \frac{5}{1 + R_{0,1}} + \frac{105}{(1 + R_{0,2})^2} \Rightarrow R_{0,2} = 4.54\%.$$

Lastly $R_{0,3}$ follows by taking

$$106.81 = \frac{8.5}{1 + R_{0,1}} + \frac{8.5}{(1 + R_{0,2})^2} + \frac{108.5}{(1 + R_{0,3})^3} \Rightarrow R_{0,3} = 6.12\%.$$

a2)

Bond Z has the highest convexity among the 3 given bonds. In fact the convexity C can be written as:

$$C = \frac{1}{2} \cdot \frac{1}{P} \cdot \frac{1}{(1+k)^2} \cdot \sum_{t=1}^T \frac{(t) \cdot (t+1) \cdot CF_t}{(1+k)^t} = \frac{1}{2} \cdot \frac{1}{(1+k)^2} \cdot \sum_{t=1}^T t \cdot (t+1) \cdot w_t$$

where w_t is the weight of the present value of the cashflow occurring at time t over the present value of all cash flows : $w_t = \frac{CF_t / (1+k)^t}{P}$ [the factor $\frac{1}{2}$, depending on the definition of convexity, can be discarded].

With bond Z, the sum occurs over three terms, and the last term (which contributes with the largest amount, since the repayment of the principal is usually the cashflow with the largest weight) is $12 \cdot w_3$. whereas with bond Y the last term is $6 \cdot w_2$. and with bond X the only term is $2 \cdot w_1$.

b)

b1)

A holding period return of zero implies that the price paid today (100.94%) is equal to the price of the bond in one year plus the earned coupon (5%). Therefore the price of the bond in one year is 95.94%.

In 1 year bond Y has a remaining time to maturity of 1 year. So $95.94\% = 105 / (1+x) \Rightarrow x = 9.44\%$ which is the break-even discount rate that is sought.

b2)

The Option-Adjusted-Spread (OAS) of puttable bonds can be expressed as

OAS = Spread of puttable bond + put option premium.

$$145 = 95 + x$$

$\Rightarrow x = 50$ [bp p.a.] for the put premium.

b3)

- An investor in a puttable bond is long the embedded put option.
- Options increase in value with higher volatilities (all other factors remaining unchanged).
- As a result, the price of puttable bonds is increasing with higher volatilities.

c)

- Interest rate risk (the magnitude of change is depending on time to maturity, coupon, call rights and yield level)
- Re-investment risk - Risk of issuer exercising his call right
- Volatility risk (higher volatilities imply lower prices for callable bonds)
- Credit risk associated with investments in the given subordinated bond
- Liquidity risk
- Foreign currency risk
- Inflation risk
- Event risk (e.g. new tax legislation)
- Country risk

d)

d1)

- After 1 year the price of the former USD par bond is: $(106) / (1 + 4.00\%)^1 = 101.92$ [%]

Consequently, the holding period return of the USD bond after one year is equal to $(6 + 101.92 - 100) / 100 = 7.92$ [%].

- Bond Y trades after 1 year at $(105) / (1 + 3\%)^1 = 101.94$ [%] which gives you a holding period return of $(5 + 101.94 - 100.94) / 100.94 = 5.94$ [%].
- Be R_{fx} the return of the USD against the EUR over the one year period. We search R_{fx} such that $(1 + 7.92\%) \cdot (1 + R_{fx}) = (1 + 5.94\%) \Rightarrow R_{fx} = -1.83\%$.

Therefore the break even exchange rate X will solve:

$$\frac{1}{1.34} \cdot (1 - 1.83\%) = \frac{1}{X} \Rightarrow X = \frac{1.34}{1 - 1.83\%} = 1.365.$$

[Note: The result of 1.365 can be interpreted as the 1-year forward EUR/USD-rate under the 'no arbitrage condition'. i.e. EUR and USD investments generate the same return.]

d2)

- Selling forward all USD proceeds into EUR ultimately results in a EUR income stream.
- Under the 'no arbitrage condition' the weaker USD forward rates (compared to the current rate of 1.34) exactly offset the current yield advantage of the USD bond.

Since the equal default risk does not matter the resulting holding period return of the two bonds is exactly the same.