

Spot rates  $\Rightarrow$  Bond price

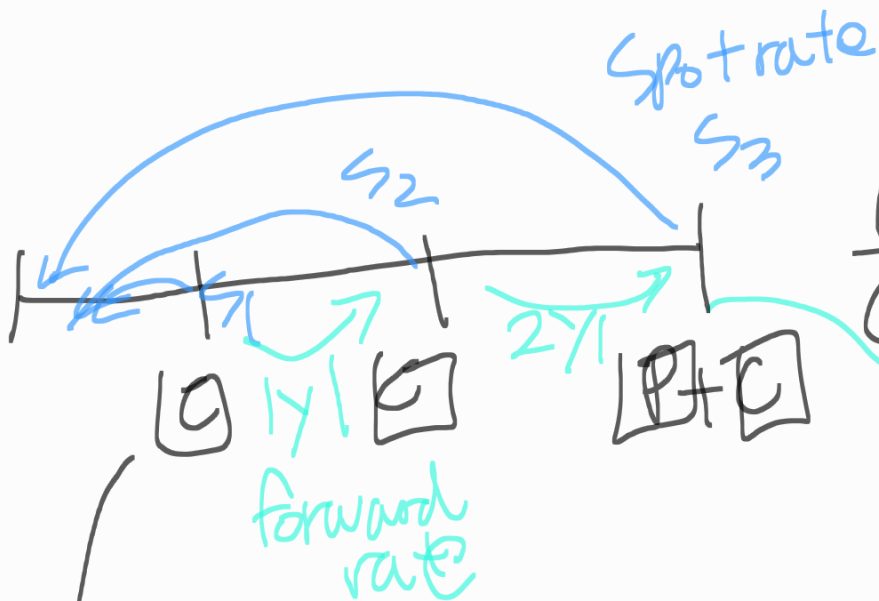
i.e) 3-year, 5% annual coupon bond, 

1-year	3%
2-year	4%
3-year	5%

$$\Rightarrow \frac{5}{(1.03)^1} + \frac{5}{(1.04)^2} + \frac{105}{(1.05)^3} = 101.180$$

= Equilibrium price

no-arbitrage price,  
Riskless profit



Converting to YTM,  
Actual pricing is based on spot rates

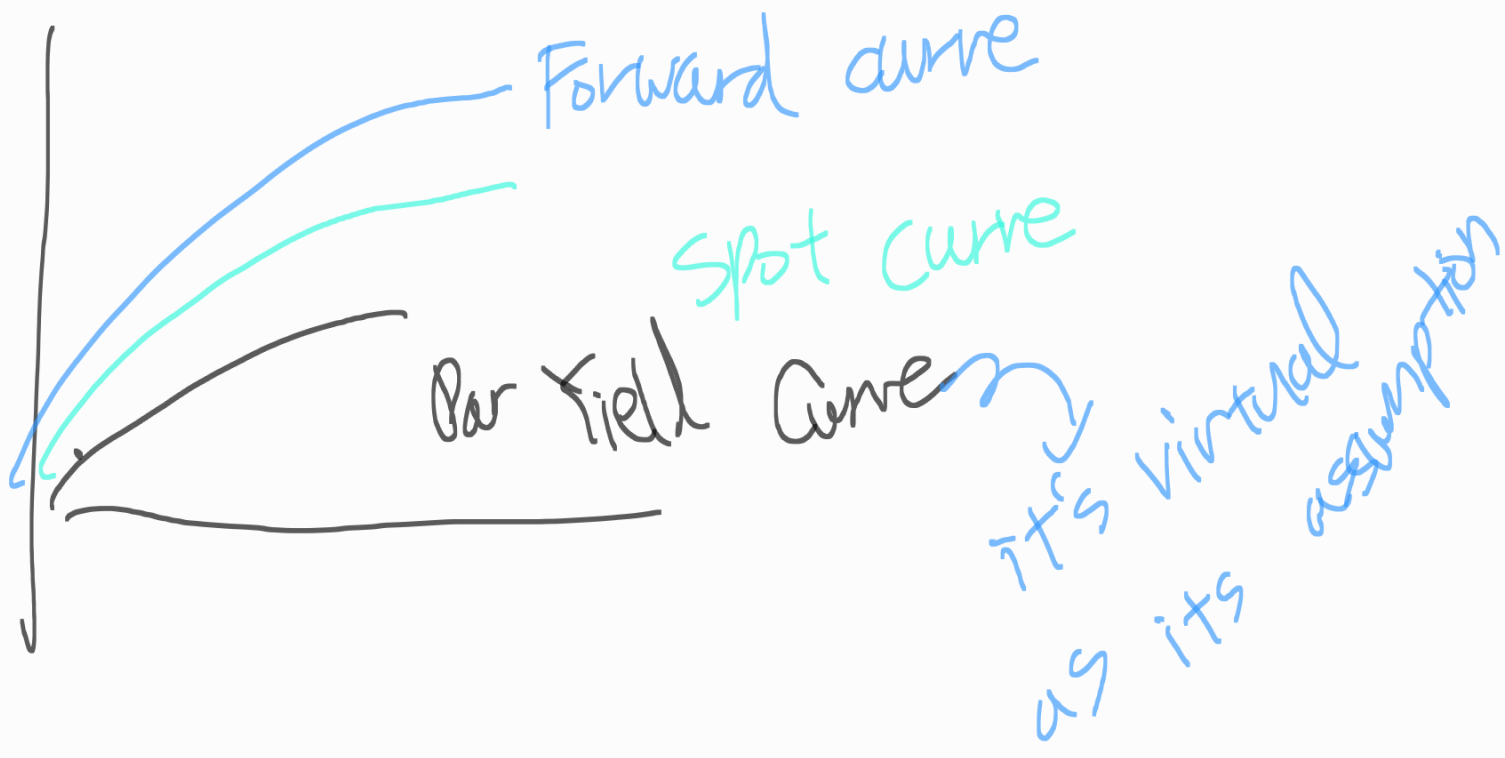
Par yield, Given Spot rate,

How much "payment" to make

price = par

$$100 = \frac{PMT}{1+s_1} + \frac{PMT}{(1+s_2)^2} + \frac{100+PMT}{(1+s_3)^3}$$

$$\Rightarrow s_2 = \sqrt{(1+f_1)(1+s_1)} - 1$$

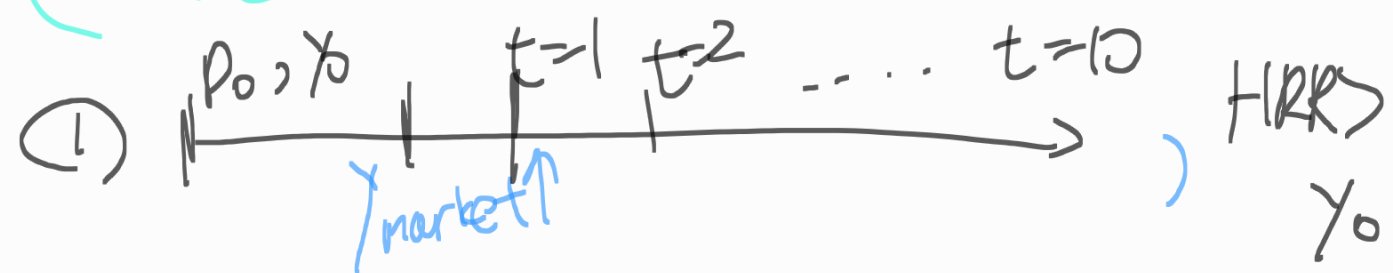


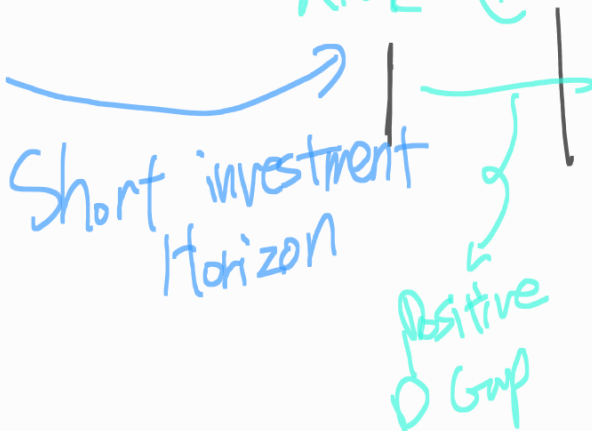
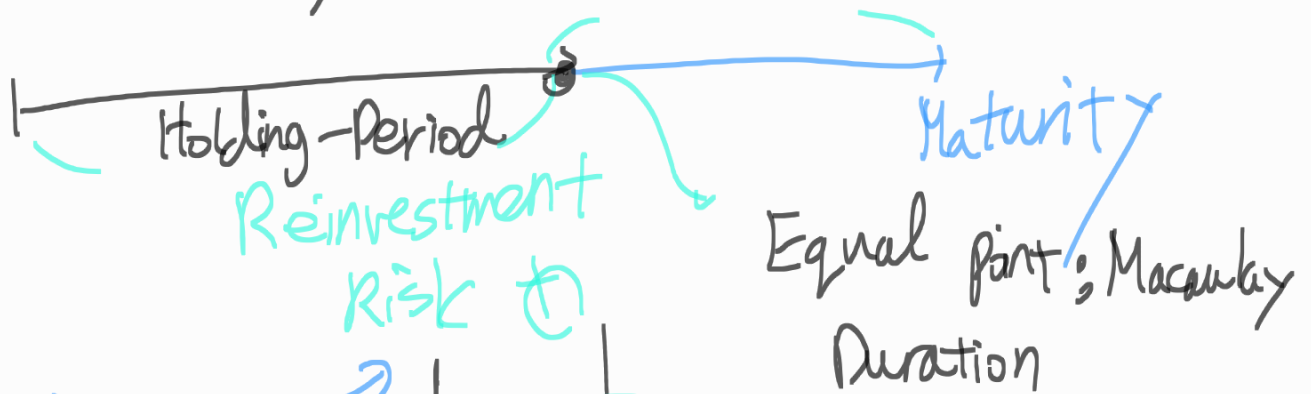
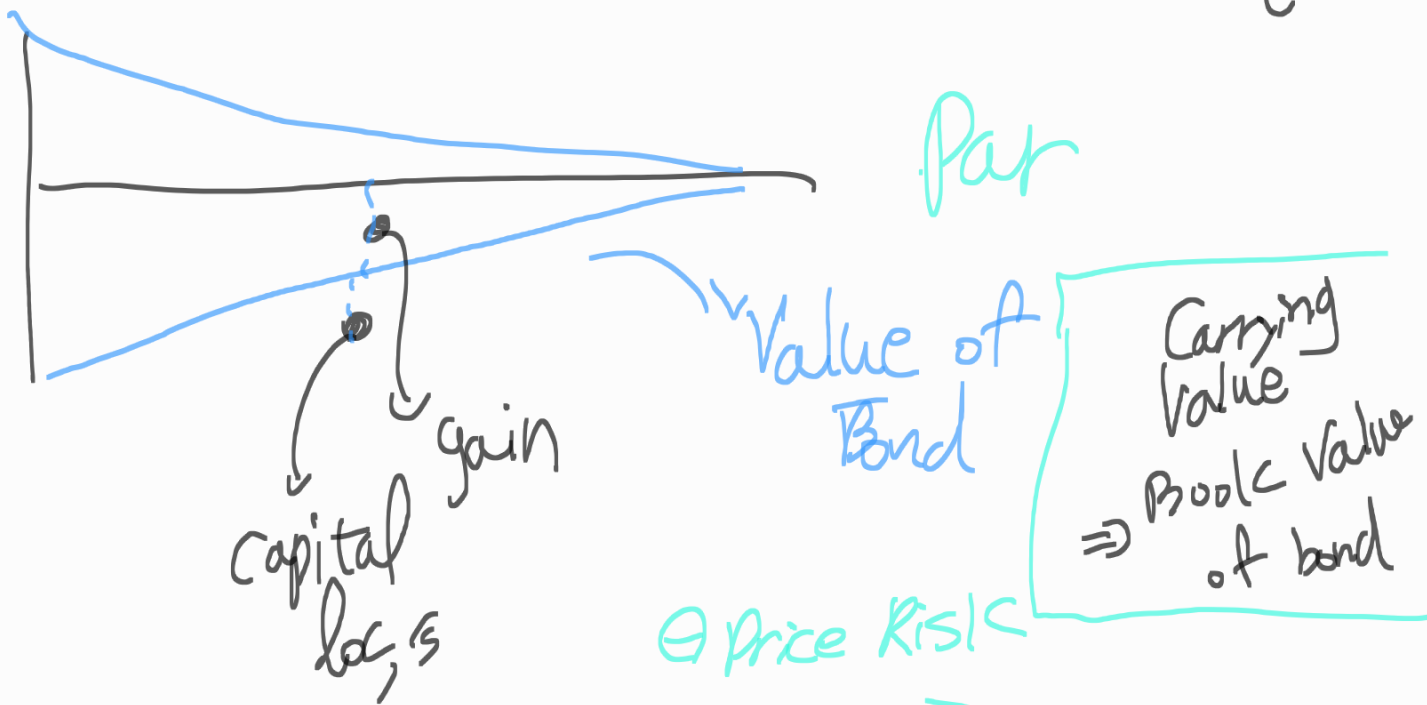
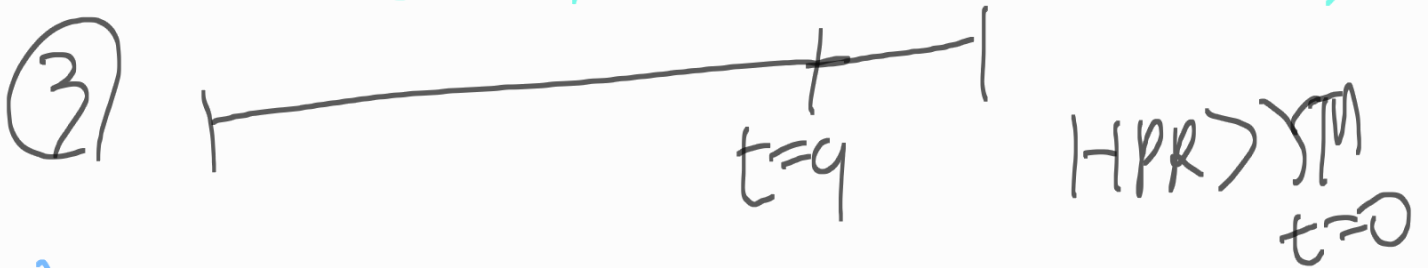
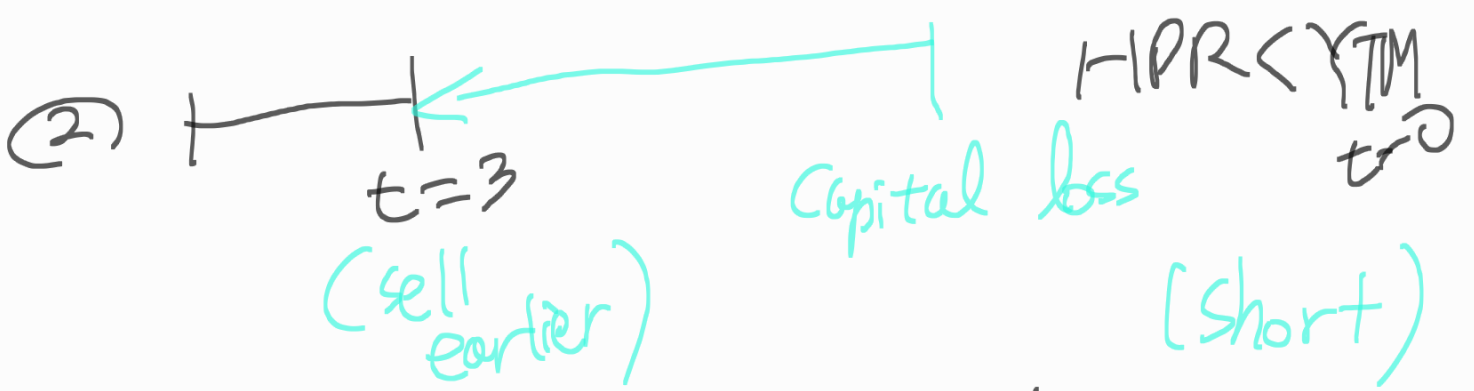
# \* Interest Rate Risk

## Assumptions

coupon, par guaranteed  
YTM of Bond = Reinvestment rate

- ① YTM fixed till the end
- ② YTM for maturity = sold before Maturity
- ③ if Market YTM  $\uparrow$   $\Rightarrow$  Realized Return  $\uparrow$
- ④, ⑤





Equal part; Macaulay Duration  
 (Even if YTM changes before coupon, Realized Ratio remains as Macaulay Duration)

Sensitivity toward market YTM changes?

$$\Rightarrow \text{Modified Duration} = \frac{\frac{\Delta P}{P_0}}{\Delta Y \cdot YTM}$$

$$= \frac{\text{Macaulay } D}{1 + YTM}$$

$$\Rightarrow \text{Macaulay Duration} \times \Delta Y = \frac{\Delta P}{P}$$

$$\Rightarrow \text{Coupon}_1 = 10 \Rightarrow \frac{10}{YTM} = PV_1 \Rightarrow W_1 = \frac{PV_1}{\text{price}}$$

$$\text{Coupon}_2 = 10 \Rightarrow \frac{10}{YTM^2} = PV_2 \Rightarrow W_2 = \frac{PV_2}{\text{price}}$$

⋮

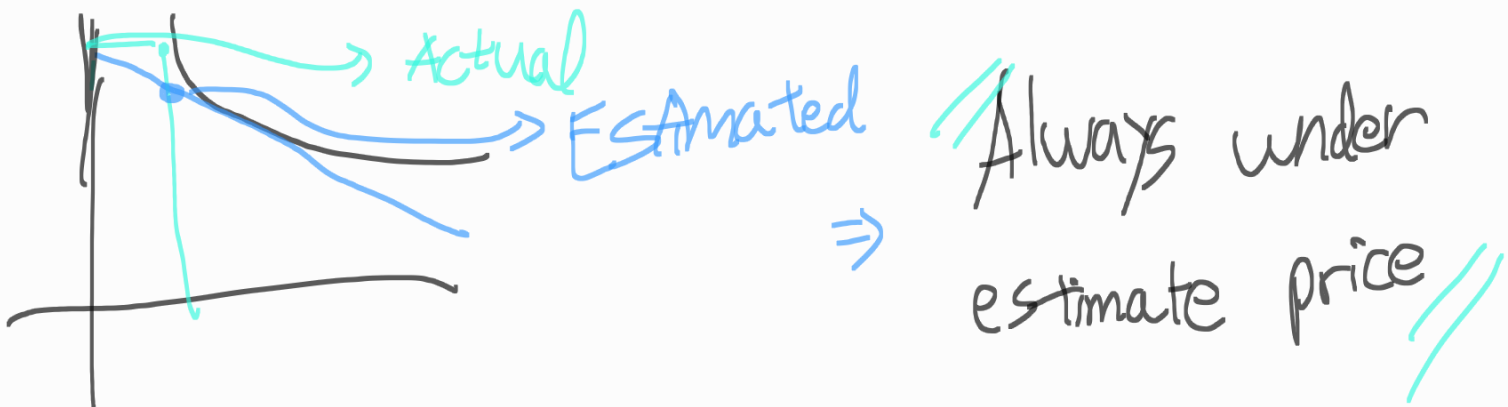
$$\text{Mac Duration} = W_1 \cdot 1 + W_2 \cdot 2 + W_3 \cdot 3 + \dots$$

⚡ Approximate Modified Duration

$$\frac{P_+ - P_-}{2 \cdot \underbrace{V_0}_{\text{original price}} \cdot \Delta Y}$$

Linear Approximation of relation btw price & YTM

⇒ Poor result as change ↑



\* Money duration = annual Mod Duration  $\times$  Full price of Bond

\* Price value of Basis point

If there is a change in YTM by 1BP  $\Rightarrow$  How much varies?

$\downarrow$  Conclusion

① MD = f (Maturity  $\uparrow$ , Coupon, yield level)

Coupon  $\uparrow$ , MD  $\downarrow$

Exception: Discount Bond

(Zero coupon bond: MD  $\uparrow$ )

101.7415      2.4  
104.12030      2.5