Debt Investment

a. Measuring bond portfolio risk with ***duration***

1. Duration measures

(1) Macaulay duration (D)(Unadjusted duration):$D = (\triangle P/P) / (\triangle r/(1+r))$

(2) Modified duration (D*)(Adjusted duration):$D^* = (\triangle P/P) / (\triangle r)$

Or $D^* = D/(1+r)$

(3) Effective duration $D_E = (P_- - P_+) / (2P_0 \triangle r)$

(4) Dollar duration $D = P \times D^* \times \triangle r$

(5) Rate duration

Measures the exposure of a portfolio to a change in the yield for one specific point of the yield curve.

(6) Spread duration (D_S)

(7) Economic Surplus=MV of portfolio-MV of liability stream.

b. Domestic bond management strategies

1. Pure bond indexing:
2. Enhanced indexing by matching primary risk factors:
3. Enhanced indexing by minor risk factor mismatching:
4. Active management by larger risk factor mismatches:
5. "Full-blow" active:

c. Immunization risk

1. The most important assumption in classical is that the yield will always ***shift in parallel***, otherwise, the immunization strategy will not work perfectly. This is called ***immunization risk.*** ➔***Matching the duration*** of the portfolio to that of liability is a ***necessary*** condition for immunization, but it may ***not be sufficient***.

d. Contingent immunization

1. When the market value of portfolio $>$ the market value of liability ➔ ***active management***.➔ so may earn higher return.
2. When the market value of portfolio = the market value of liability ➔ ***move to immunization***.➔ so may fund the liability at maturity.
3. ***Dollar safety margin*** = market value of portfolio - the market value of liability
4. ***Cushion spread*** = available immunized return – safety net return (required minima return)

e. Immunizing a stream of liabilities

1. There are rules for immunization:

(1) The PV of the portfolio must not lesser than the PV of the liabilities.

(2) The duration of the portfolio must equal to the duration of the liabilities.

(3) The distribution of the durations of the portfolio should be somewhat greater than the distribution of the durations of the liabilities.(but not too much)

(4) Monitoring and adjusting continuously.

2. Strategies for immunizing a s tream of liabilities

(1) *Cash flow matching* ➔ *safest* but most *expensive*.(lowest return)

(2) Horizon (combination) matching ➔ *hybrid*

i. Near-term liabilities ➔ cash flow matching.

ii. Longer-term liabilities ➔ duration matching.

(3) Multiple liability immunization ➔ duration matching

i. More aggressive and higher expected return..

ii. Monitoring and rebalancing are important.

(4) Contingent immunization ➔ active management.

f. Interest rate parity and the forward premium/discount

1. Interest rate parity:

$1*(1+ r_x) = 1* S_{x/y}*(1+ r_y)/ F_{x/y}$ ➔ $F_{x/y} = S_{x/y}*(1+ r_y)/ (1+ r_x)$

2. The Forward premium/discount

Forward premium/discount = Forward rate – spot rate = $F_{x/y} - S_{x/y}$

In case of $F_{x/y} - S_{x/y} > 0$ ➔ Forward premium, otherwise, Forward discount.

In terms of percentage:

Forward premium/discount(%)= (Forward rate)/ (spot rate) - 1= $F_{x/y} / S_{x/y} - 1$

$= (1+ r_y)/ (1+ r_x) - 1 \fallingdotseq r_y - r_x$

g. Calculating returns for an international portfolio

1. Sources of returns:

(1) Cash returns: short-term interest rate.

(2) Excess bond market returns: local bond market return – local risk free rate.

(3) Excess currency returns: projected currency returns – forward premiums that must be borne to obtain that currency exposure.

2. Expected return of a portfolio combination =

Cash returns + Excess bond market returns + Excess currency returns

NOTE: 1.What's Cross-hedged

➔ to offset original position and create another position which is expected to outperform.(one position only)

USD➔EUR

EUR➔USD

USD➔GBP

2. What's Proxy-hedged

➔ to hold the original position and create another position which is expected to outperform.(two positions)

USD➔EUR

JPY➔USD

Derivative instruments-I—Forward and Futures

a. T-Bill futures contracts refer to discount yield, but Eurodollar futures contracts refer to interest-bearing yield.

b. T-Bill contracts are deliverable, but Eurodollar contracts are non-deliverable.

c. Treasury Bond Futures Contracts

Invoice Price = F * Conversion Factor(CF) + accrued Interest

d. **To determine the position have to be taken to adjust the dollar duration**

$D\$_F = D\$_T - D\$_P$

Where, $D\$_T$ = target dollar duration of the portfolio.

$D\$_P$ = dollar duration of the portfolio, without futures.

$D\$_F$ = dollar duration of the futures position.

e. How many contracts to Buy/Sell

$N_F = (D\$_T - D\$_P)/ D\$_f$

Where, N_F = the number of futures contracts .

$D\$_f$ = dollar duration per futures contract.

f. Compute the dollar duration of a futures contract.

$(\text{Dollar Duration})_F = (\text{Dollar duration})_{CTD}/(\text{Conversion factor})_{CTD}$

g. Hedging with interest rate futures

1. Kinds of hedge:
   (1) Short (Sell) hedge ➔ to short(sell) futures to hedge
   (2) Long (Buy) hedge ➔ to long(buy) futures to hedge
   (3) Cross hedge ➔ the bond being hedged is not identical to the bond specified in the futures contract. ➔ most cases in the kind.➔ **hedge ratio and yield beta** are the issues.
2. The number of futures contracts required to hedge a bond.
   (1) How to calculate how many contracts required to hedge a bond?
   $N_F = (\text{Dollar Duration}_{B(ond)})/(\text{Dollar Duration}_{F(utures)})$*Yield Beta
      i. What's **yield beta**?
      ➔ Yield volatility of bond relative to the yield volatility of futures contract.➔ if the bond's yield volatility get higher relative to the futures ➔ more contracts needed to hedge.
   (2) There are 3 major sources of hedging error:
      i. Incorrect expected **dollar duration**: especially for bonds embedded options.
      ii. The projected **basis** is incorrect: basis is difficult to predict, so that is a more serious problem than duration, especially for hedging lifted before settlement. Even the hedge is held to expiration, another assumption—spread remain constant—has to be made.
      iii. The **yield beta** may be measured incorrectly.

h. Equity risk management

1. Using equity futures contracts to achieve target **beta** for a stock portfolio.
2. Constructing synthetic stock index

Long stock = Long futures + Long risk-free debt

➔ A synthetic equity position can be created by combining futures on the desired index with

a risk-free asset.

➔ To turn idle cash into an equity position (equitizing cash)

3. Creating cash from equity

Long stock = Long futures + Long risk-free debt

➔ Long stocks + **Short futures** = Long risk-free debt

➔ This is a strategy for managers to lock in a portfolio's current value for a period of time

➔ To adjust the portfolio's beta to Zero.

i. Stock/Bond asset allocation

Using equity and bond futures to adjust the allocation of a portfolio between equity and debt.

j. Managing currency risk

(1) The optimal hedge ratio captures the covariance of asset returns with exchange rate change.➔ It will minimize both **translation risk and economic risk.**

(2) **Optimal hedge ratio = h_{OP} = COV(R_D, R_F)/ σ_F^2**

where R_D = portfolio return in **domestic** currency terms.

R_F = percent change in futures price. σ_F = variance of the futures return.

Derivative instruments-II--Options and Swaps

A. Options

a. Butterfly spread

1. Long butterfly spread➔ short volatility

Short butterfly spread➔ long volatility

2. Decompose butterfly spread (high + low = 2*middle)

(1) Long butterfly spread by call➔Long call at high and low, sell call*2 at middle

(2) Long butterfly spread by put➔Long put at high and low, sell put*2 at middle

(3) Short butterfly spread by call➔Short call at high and low, long call*2 at middle

(4) Short butterfly spread by put➔Long put at high and low, sell put*2 at middle

b. Interest rate strategies

1. Interest call (put) for borrower (lender) to manage interest rate risk of future loan.

2. To eliminate interest rate risk by an interest rate **Cap/Floor/Collar.**

Cap (Floor) = **a series of interest rate Call** (Put) options.

c. Delta hedging

1. A fully-hedged(delta neutral) option portfolio can a risk-free rate of return.

2. Delta = $\triangle$ = δ = $\triangle C/\triangle P$

B. Swaps

a. Using swaps to convert floating (fixed) rate loan to fixed (floating rate) loan.

Its quite easy(Interest rate Swap➔IRS)

b. (Cross) Currency Swap(CCS)：to convert one currency loan to another.

c. Equity Swap

1.Equity Swap link one set of exchanged cash flow to the price of a equity return.

2. No principal amount exchanged.

d. Interest rate Swaptions

1. An interest rate swaption is an option on an interest rate swap.
2. Two kinds of interest rate Swaption:
   (a) Receiver Swaption➔ The right to enter a swap to receive fixed rate.
   (b) Payer Swaption➔ The right to enter a swap to pay fixed rate.
3. Applications of a Swaption
   (a) To hedge a future loan from floating (fixed) rate to fixed (floating) rate.
   (b) Convert callable(noncallable) debt into noncallable(callable) debt.
      i. Convert callable debt into noncallable debt.➔to **sell** a receiver swaption.
      ii. Convert noncallable debt into callable debt.➔to **buy** a receiver swaption.

e. Credit derivatives

1. Types of credit derivatives:
   (1) Total return swap (TRS)；(2) Credit default swap (CDS)；(3) Credit spread option.
2. Credit default option
   (1). Binary credit option➔ digital payout, subject to default event.
   (2). Binary credit put option➔ the buyer can put the bond at par if the bond is downgraded to a specific rating.
   (3). Credit put option.➔ the buyer can put the bond at strike at expiration.
3. Credit spread option
4. Credit forward contracts
   The payout of a credit forward contract based on the formula:
   Payout = (credit spread at expiration-contracted spread)*RF*Notional
   ➔ If the spread **widen➔ buyer** of credit forward will **receive** payment, and the seller has to pay.
   ➔ If the spread **narrow➔ seller** of credit forward will **receive** payment, and the buyer has to pay.
   ➔ The same as other forward contracts, the **payout** of credit forward contracts are **linear.**
5. Basket default swap
   (1) Nth-to-default swap➔ the protection buyer only receives payment after N reference entities default, not before.
   (2) Subordinate basket default swap
   (3) Senior basket default swap

C. Hedging accounting

a. Under FAS 133 and IAS 39, all derivatives have to be recognized on financial statements at fair value in *net income, except when they are part of designated hedged.* .

b. Derivatives can serve as a tool in one of : cash flow hedge, fair value hedge, or foreign currency hedge.(To hedge an expected payment denominated in a foreign currency is cash flow hedge.)

c. Changes in a derivative in a cash flow hedge are offset in comprehensive income on the balance

sheet.

d. Changes in a derivative in a fair value hedge must be recognized in earnings..

e. The ineffective portion of a hedging activity has to be recognized as net income.

f. Accounting hedges v.s. Economic hedges

Accounting hedges➔Gain and loss can be offset with accounting entries.➔e.g. derivatives hedging.

Economic hedges(Natural hedges)➔the price risk of inputs can be transfer to outputs.