

## APPENDIX O (SELECTED QUESTIONS FROM OLD EXAMS)

### Midterm 2

#### M2.I Short questions (10 points each)

1. (CHAPTER XIII). It is January 2. You are the manager of a Eurobond portfolio worth USD 28 million. You are worried about interest rate volatility in the next twelve months. The average duration of the portfolio is 7.8 years with an annual YTM of 6.8%. The December T-bond futures price is currently 108-25, with an annual yield of 7.2%, and the cheapest-to-deliver bond has a duration of 7.1 years.

A. Using December T-bond futures contracts, how should you hedge against changes in interest rates in the next 12 months?

B. Suppose interest rates decreased during the 12-month period the hedge was established. Was the decision to hedge justified?

ANSWER:

A.

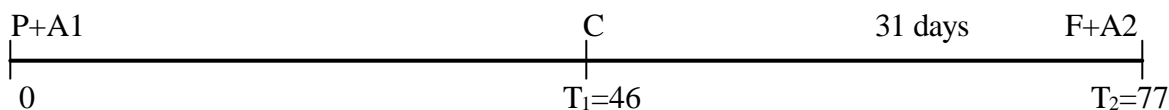
$$N = [S D_S (1 + YTM_F)] / [F D_F (1 + YTM_S)] = [\text{USD } 28,000,000 \times 7.8 \times (1.072)] / [\text{USD } 108,781.25 \times 7.1 \times (1.068)]$$

$N = 283.83$  contracts.  $\Rightarrow$  Short 284 contracts to hedge the Eurobond portfolio.

B. Since interest rates decreased, the Eurobond portfolio's value increased. A no-hedge strategy would have been more profitable. The hedge, however, was established to maintain the value of the portfolio and, therefore, the decision to hedge seems justified.

2. (CHAPTER XIII). It is June 15. A Treasury bond is trading at a price of 92'14 and has a 8% coupon payable on August 1 and February 1. Short-term interest rates as of June 15 are 5% for two-months or less and 5.5% for three months. Calculate the forward price of the bond (F) calculated to September 1.

ANSWER:



$$P = 92.4375$$

$$r_1 = .05$$

$$r_2 = .055$$

$$C = .08$$

$$T_1 = 15 + 31 = 46$$

$$T_2 = 15 + 31 + 31 = 77$$

$$A1 = .08/2 \times 134/181 \times 100 = 2.9613$$

$$A2 = .08/2 \times 31/184 \times 100 = 0.6739$$

$$F = (92.4375 + 2.9613)(1 + .055 \times 77/360) - .08/2 \times [(1 + .055 \times 77/360) / (1 + .05 \times 46/360)] - 0.6739 = 95.80695$$

3. (CHAPTER XIII) Mr. Splinter, manager of One Foot Portfolio, has JPY 1,500,000,000 in a stock portfolio whose composition matches the Nikkei 225 and JPY 2,000,000,000 in a bond portfolio with a modified duration of 6.2 years. Mr. Splinter believes Japanese interest rates are going to be significantly reduced in the next three months by the Bank of Japan. He also expects the Japanese stock market to remain at the actual level for the next three months. Assume that the JGB CDB bond contract with a modified duration of 7.9 years, and it is trading at 93.50. The face value of JGB futures bonds is JPY 10,000,000. Assume the three-month Nikkei 225 is trading at 18015 (the multiplier is equal to USD 5, and the exchange rate is .0098 USD/JPY). Assume transaction costs are high enough to prevent Mr. Splinter to change his portfolio allocation for three months. Calculate the number of T-bond futures contracts and stock index futures contracts needed to take advantage of the change in interest rates. (Specify which contracts he is going to sell and which contracts he is going to buy).

ANSWER:

- Number of 3-mo. JGB contracts to buy to increase One Foot Portfolio's bond position by JPY 1.5B.

$$N = 6.2 (\text{JPY } 3.5\text{B} - \text{JPY } 2.0\text{B}) / [7.9 \times .9350 \times 0.01\text{B}] = 125 \text{ contract} \quad \Rightarrow \text{buy 125 JGBs futures}$$

- Now, take a JPY 1.5B short position in stocks, using 3-mo Nikkei futures.

$$N = \text{JPY } -1.5\text{B} / [18,015 \times 5 / .0098] = -163.2 \text{ contracts} \quad \Rightarrow \text{Short 163 Nikkei futures.}$$

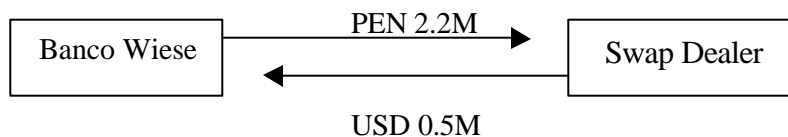
4. (CHAPTER XIV). Suppose that the term structure of interest rates is flat in the United States and Peru. The dollar interest rate is 6% per year while the Peruvian nuevo sol interest rate (PEN) is 15%. The current exchange rate is USD 1 = PEN 2.25. Under the terms of a swap agreement, Banco Wiese, a financial institution, pays 10% per year in PEN and receives 5% in USD. The principals in the two currencies are USD 10 million and PEN 22 million. Payments are exchanged every year. The swap will last two more years. What is the value of the swap to Banco Wiese?

ANSWER:

$$i_{\text{USD}} = .06$$

$$i_{\text{PEN}} = .15$$

$$S_t = .4444 \text{ USD/PEN}$$



$$B_{\text{USD}} = \text{USD } 0.5\text{M} / (1.06) + \text{USD } 10.5 / (1.06)^2 = \text{USD } 9,816,661$$

$$B_{\text{PEN}} = \text{PEN } 2.2\text{M} / (1.15) + \text{PEN } 24.2 / (1.15)^2 = \text{PEN } 20,211,721$$

$$\text{Value of Swap (Banco Wiese)} = B_{\text{USD}} 9,816,661 - \text{PEN } 20,211,721 \times .4444 \text{ USD/PEN} = \text{USD } 833,674$$

5. (CHAPTER XIV). CEMEX is a leading Mexican construction company. CEMEX has USD 200 million of short-term debt. CEMEX has decided to refinance the USD short-term debt with a straight 2-year 11% Euro-USD bond. Each bond has denomination of USD 1,000. Market competitive pressures have recently driven down the commissions paid for issuing straight bonds to 1½%. An investment bank approaches CEMEX and offers to issue a similar straight bond, but with tradeable four-year currency warrants attached giving entitlement to European USD/MXP calls. Each bond of USD 1,000 has a detachable warrant giving the holder the right to receive the difference between (1) the USD equivalent of MXP 10,000 at the rate of 0.09 USD/MXP and (2) the USD equivalent of MXP 10,000 at the then prevailing exchange rate. To value the USD/MXP put, you should use the Black-Scholes formula with the following inputs: the exchange rate is .10 USD/MXP, the strike price USD is .09 USD/MXP, the USD risk-free rate is 6%, MXP risk-free rate is 10%, and the annual USD/MXP volatility during the past four years was 20.60%.

A. Following standard market practices, calculate the cost of funds.

B. Discuss the advantages and disadvantages of the proposed 2-year CEMEX bond.

C. Propose a solution to reduce currency risk.

ANSWER:

A.

• Currency warrants (using the Black-Scholes formula for currency options):

$$\text{Call} = C = S e^{-r_{fx}T} N(d1) - X e^{-r_{dx}T} N(d2)$$

$$d1 = 0.07354 \quad \Rightarrow N(d1) = 0.5292$$

$$d2 = -0.33866 \quad \Rightarrow N(d2) = 0.3674$$

$$C = .10 \times e^{-.10 \times 4} \times 0.5293 - .09 \times e^{-.06 \times 4} \times 0.3674 = \text{USD } .0095 \text{ per MXP}$$

$$P = C - S e^{-r_{fx}T} + X e^{-r_{dx}T} = \text{USD } .0132 \text{ per MXP.}$$

Warrant price: USD 0.0132 per MXP, or USD 132 per bond (13.2% per bond).

• Cost of funds

T = 2 years.

Issue price = 100% + 13.2% = 113.20%

CFs: net receipt at issue = USD 200,000,000 (1.132 - .0150) = USD 223,400,000

annual coupon payments = USD 22,000,000.

principal repayment = USD 200,000,000.

Cost of funds (including commissions) = 4.73%

B.

**Advantage:** Very low cost of funds. The cost of funds is 627 bps below the usual cost of funds for CEMEX.

**Disadvantage:** CEMEX is involved in a currency play. The USD/MXP puts have a moderate probability of being exercised at maturity, since they are already in-the-money.

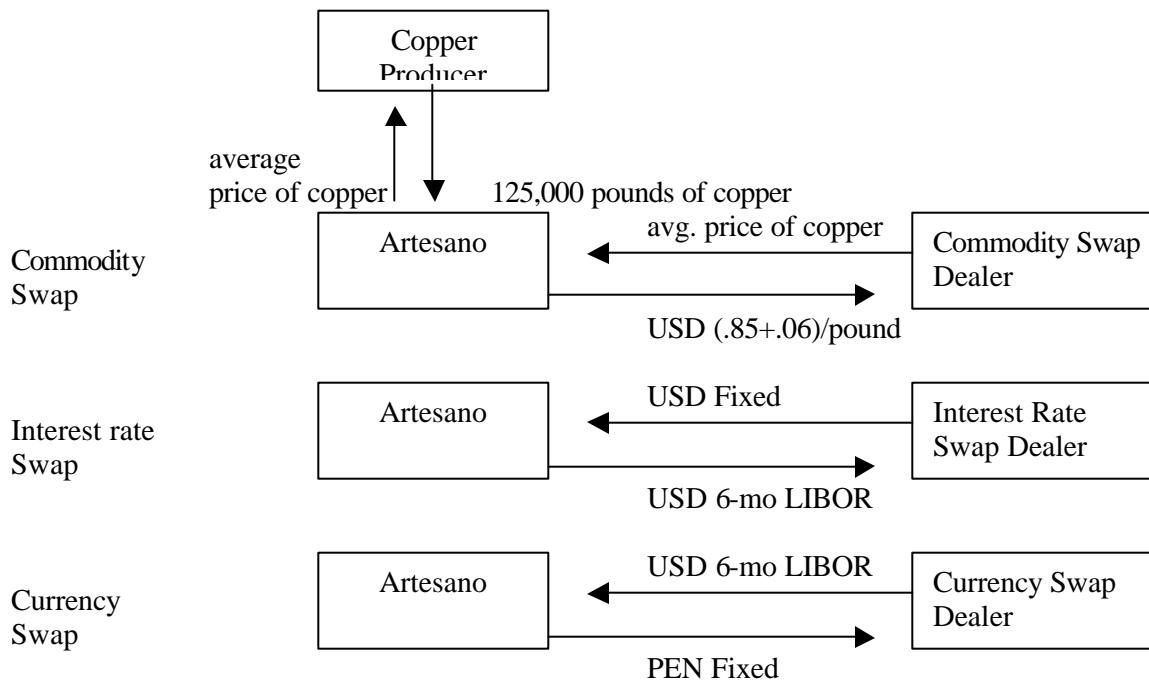
C. A solution to minimize currency risk is to sell a 4-year USD/MXP forward contract. Using IRPT, we obtain  $F_{1,4} = .0862$  USD/MXP. Therefore, if CEMEX sells MXP forward at this rate, CEMEX fixes the USD cost of its currency play (sells MXP 2,000,000,000 for USD 172,400,000).

6.- (CHAPTER XIV). Artesano Ltd., a Peruvian firm, produces copper bracelets. Artesano buys a quarter million pounds of copper a year. The price of a pound of copper in international markets is in USD. The manager of Artesano, Mr. Cobre, is uneasy about the short-term exchange rate exposure and decides to fix the price of a pound of copper in terms of soles (PEN) for two years. You work for Mr. Cobre. A commodity swap dealer offers a two-year mid-quote price of USD .85 per pound of copper (the dealer spread is USD .12). Two-year swap interest rates are available at a rate of 7% against 6-mo. LIBOR. Two-year PEN-for-USD currency swaps are available at a rate of 18% against 6mo. LIBOR. The current exchange rate is 2.81 PEN/USD.

- A. Present in an exhibit your proposed structured solution to Cobre's problem.  
 B. Determine the price of copper in terms of PEN.

ANSWER:

A. Structured Solution

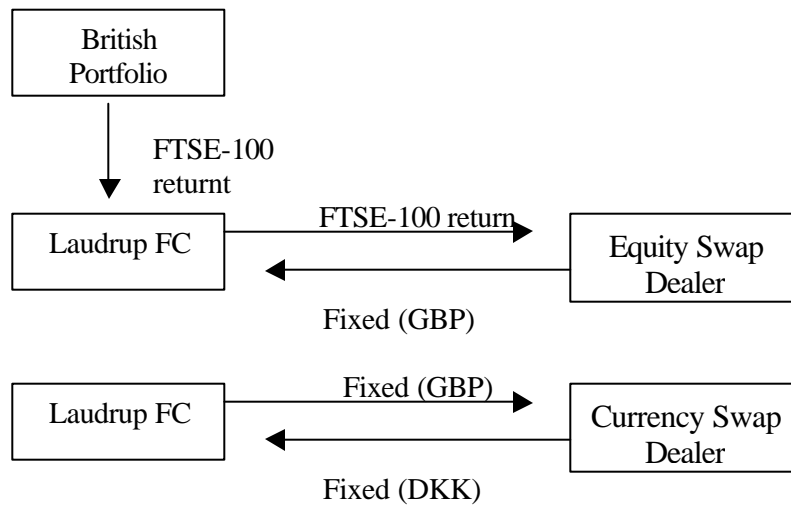


B. Price of coffee in terms of PEN.

- (1) Fixed semiannual payments to commodity swap dealer:  $125,000 \times \text{USD } .91 = \text{USD } 113,750.$
- (2) Notional principal on a USD interest rate swap:  $\text{USD } 113,750 / .035 = \text{USD } 3,250,000.$
- (3) PV of CFs:  $\text{PV}(113,750, .035, 4 \text{ periods}) = \text{USD } 417,813.$
- (4) Translate to PV of CFs PEN:  $\text{USD } 417,813 \times 2.81 \text{ PEN/USD} = \text{PEN } 1,174,053.9$
- (5) Coupon on the fixed-rate side of PEN-for-USD swap:  
 $\text{Coupon}(\text{PV}=1,174,053.9, .09, 4 \text{ periods}) = \text{PEN } 362,394$
- (6). Price of copper =  $\text{PEN } 362,394 / 125,00 = 2.90 \text{ PEN/pound of copper}.$

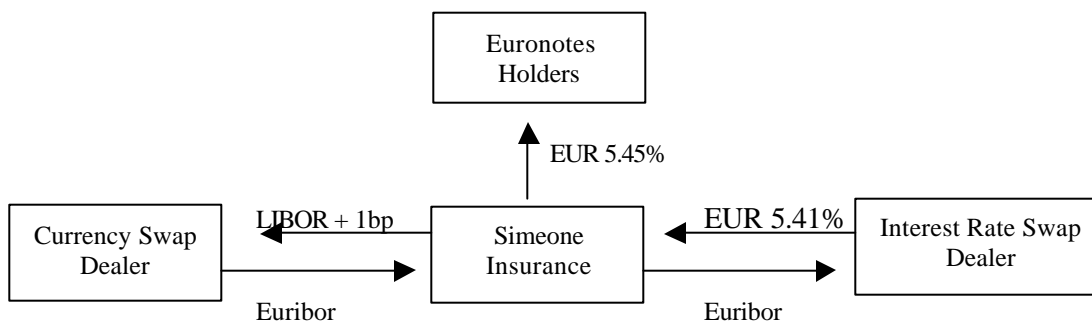
7.- (CHAPTER XIV). Laudrup F.C., a Danish fund, holds a British stock portfolio on which it earns a volatile equity return which is highly correlated with the FT-100 index (the U.K. stock index). This return is in GBP. The manager of Laudrup, Mr. Piazza, decides to have all foreign income in the form of fixed-rate DKK. You work for Mr. Piazza. Present in an exhibit your proposed structured solution to Mr. Piazza's problem.

ANSWER:



8.- (CHAPTER XIV). (Adapted from Riskpublications.com) During the first semester of the year 1999, the cost of swapping a medium term Eurobond to USD was 5bp to 6bp, which was considered too high for many USD borrowers. While increased EUR exposure was attractive for U.S. companies, the cost was considered too high. In June 1999, liquidity improved in the currency swap market and U.S. borrowers took advantage of the diminished costs between the EUR and USD. Simeone Insurance raises USD 4 billion annually to fund its programmes. It is a regular in the international markets, and swaps all debt back to floating dollars. On July 1, 1999, Simeone priced EUR 300 million of four-year EMTN debt via CSFB and ING Barings. The proceeds were swapped into floating USD. The Euronotes yielded 5.39% annually re-offered and 5.45% all-in-cost. With interest-rate swap bids around 5.41% at the time, Simeone could have achieved around Euribor plus 4bp. The basis (flexible-for-flexible) swap to USD was 1bp at most, and perhaps even flat. The borrower confirmed that LIBOR plus 5bp had been achieved --several basis points better than Simeone would have been able to hit just a week earlier. Draw a diagram showing the all the cash flows involved in the operation that allowed Simeone to borrow at LIBOR plus 5bps.

ANSWER:



9. (CHAPTER XIV). Shell wants to increase its fixed-rate DEM debt, while UBS wants to increase its DEM floating-rate debt. Shell can borrow at 7.5% fixed or at FIBOR. UBS can borrow at 5.6% or at 1% below FIBOR. You are a swap dealer. Design an interest rate swap agreement between Shell and UBS that benefits both parties.

ANSWER:

● Swap deal:

Shell issues floating debt at FIBOR and makes coupon payments to UBS at 6%

UBS issues fixed-rate debt at 5.6% and makes (FIBOR-1) payments to Shell

● Cost of borrowings:

Shell:  $\text{FIBOR} + 6.0 - (\text{FIBOR} - 1.0) = 7.0\%$  ( $< 7.5\%$ )

UBS:  $5.6 + (\text{FIBOR} - 1) - 6.0 = (\text{FIBOR} - 1.40\%)$  ( $< \text{FIBOR} - 1\%$ )

10. (CHAPTER XIV). Suppose the term structure in Switzerland and the U.S. is flat. The annual CHF interest rate is 4%, while the annual USD interest rate is 5.2%. Goyco Corp., a U.S. firm, has entered into a currency swap where it receives 5.5% annually in USD and pays 4.3% annually in CHF. The principals in the two currencies are USD 15 million and CHF 25 million. The swap will last for another four-years. The exchange rate is .60 USD/CHF.

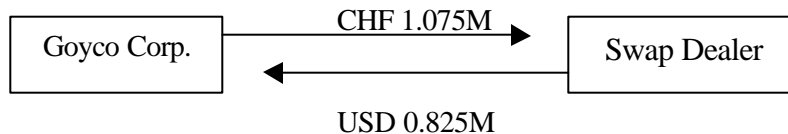
A. Value this currency swap using the forward currency contract decomposition.

B.- Three years from now, the exchange rate is .70 USD/CHF. What is the market valuation of the last year of the swap exchanges for Goyco Corp.? (Recall that the market valuation is the present value of the difference between what is stipulated in the contract and the market valuation of those payments).

ANSWER:

$$\begin{aligned}
 A.- \quad F_{t,1} &= .60 \text{ USD/CHF} \times (1.052)/(1.04) = .6069 \text{ USD/CHF} \\
 F_{t,2} &= .60 \text{ USD/CHF} \times (1.052)^2/(1.04)^2 = .6139 \text{ USD/CHF} \\
 F_{t,3} &= .60 \text{ USD/CHF} \times (1.052)^3/(1.04)^3 = .6210 \text{ USD/CHF} \\
 F_{t,4} &= .60 \text{ USD/CHF} \times (1.052)^4/(1.04)^4 = .6282 \text{ USD/CHF}
 \end{aligned}$$

Annual exchanges:



$$\begin{aligned}
 V_{1\text{st-year}} &= [ \text{USD } 0.825 - \text{CHF } 1.075 \text{ M} \times .6069 \text{ USD/CHF} ] / (1.052) = \text{USD } .164052 \\
 V_{2\text{nd-year}} &= [ \text{USD } 0.825 - \text{CHF } 1.075 \text{ M} \times .6139 \text{ USD/CHF} ] / (1.052)^2 = \text{USD } .149143 \\
 V_{3\text{rd-year}} &= [ \text{USD } 0.825 - \text{CHF } 1.075 \text{ M} \times .6210 \text{ USD/CHF} ] / (1.052)^3 = \text{USD } .135216 \\
 V_{4\text{th-year}} &= [ \text{USD } 15.825 - \text{CHF } 26.075 \text{ M} \times .6282 \text{ USD/CHF} ] / (1.052)^4 = \text{USD } -.453395
 \end{aligned}$$

$$\text{Value of swap(Goyco)} = V_{1\text{st-year}} + V_{2\text{nd-year}} + V_{3\text{rd-year}} + V_{4\text{th-year}} = \text{USD} -.004984.$$

The value of the swap for Goyco is USD -4,984.

B.- Now, the swap has one year left to maturity.

$$\begin{aligned}
 F_{t,1} &= .70 \text{ USD/CHF} \times (1.052)/(1.04) = .7081 \text{ USD/CHF} \\
 V_{4\text{th-year}} &= [ \text{USD } 15.825 - \text{CHF } 26.075 \text{ M} \times .7081 \text{ USD/CHF} ] / (1.052) = \text{USD } -2.50771
 \end{aligned}$$

Goyco's value of the swap in the last year of the agreement goes significantly up.

11. (CHAPTER XV). Consider a Swiss bank facing the following operations:

- Lend money to Unilever at LIBOR + 1%.
  - Has the option of borrowing money at LIBOR + ½% with a cap of 10% or borrow at LIBOR + 2/3%.
  - Sell a cap option at 10% to Roche for 5/8% a year.
- Should the bank engage in cap packaging?

ANSWER:

Bank's net income:

• Cap:  $(\text{LIBOR}+1) - \min(\text{LIBOR}+1/2,10) + 5/8 - \max(0,\text{LIBOR}-10)$

if LIBOR < 10%  $\Rightarrow (\text{LIBOR}+1) - (\text{LIBOR} + 1/2) + 5/8 = 1.125$

if LIBOR > 10%  $\Rightarrow (\text{LIBOR}+1) - 10 + 5/8 - (\text{LIBOR} - 10) = 1.625$

• No cap:  $(\text{LIBOR}+1) - (\text{LIBOR}+2/3) = 1/3$

YES! Swiss bank should engage in cap packaging.

12. (CHAPTER XV). On January 10, a Eurobank is offered HKD 200 million of twelve-month deposit by a customer at the bank's bid rate. The bank does not want to be exposed to gap risk.

At the current market, the other rates are these:

|           | Cash  |       | 9x12 | FRA  |       |
|-----------|-------|-------|------|------|-------|
|           | bid   | asked |      | bid  | asked |
| 9 months  | 8.500 | 8.625 |      | 8.70 | 8.80  |
| 12 months | 8.750 | 8.825 |      |      |       |

Do you advise the bank to take the twelve-month deposit? Show your calculations.

ANSWER:

From Jan 12 to Jan 12  $\Rightarrow T=365$ .

Financing Cost = HKD 200 M x 365/360 x .0875 = HKD 17,743,055.56

From Jan 12 to Oct 12  $\Rightarrow T=273$ . From Oct 12 to Jan 12  $\Rightarrow T=92$ .

Interest earned = HKD 200M x [(1 + .0850 x 273/360) x (1 + .0870 x 92/360) - 1] = HKD 17,624,958.

Financing Cost > Interest earned  $\Rightarrow$  NO!

13. (CHAPTER LN XVII). You are a U.S. investor, whose U.S. portfolio tracks the U.S. market perfectly. You are considering investing in the following foreign stock markets:

| Market    | Return (%) | SD   | $\beta_{\text{WORLD}}$ |
|-----------|------------|------|------------------------|
| Mexico    | .16        | 2.10 | .62                    |
| U.K.      | .09        | 1.05 | .84                    |
| Hong Kong | .14        | 1.50 | .49                    |
| U.S.      | .10        | 1.11 | 1.03                   |
| WORLD     | .12        | 1.01 | 1.00                   |
| $R_F$     | .05        |      |                        |

$R_F$  is the U.S. one-year Treasury Bill rate, that is, the risk free rate.  $\beta_{\text{WORLD}}$  is the beta of the foreign market with the World Index.

(A) Based on a risk-adjusted performance measure (RVOL and RVAR), rank the performance of the four markets.

ANSWER:

|        | RVAR   | RVOL  |
|--------|--------|-------|
| Mexico | .05236 | .1774 |
| UK     | .0381  | .0476 |
| HK     | .06    | .1837 |
| US     | .045   | .05   |

(B) Assume you add to your U.S. portfolio, which tracks the U.S. market, all markets with a higher RVOL than the U.S. RVOL. You give a weight of 10% to each foreign market in your expanded portfolio. What is the risk of your expanded portfolio? Is the risk of your expanded portfolio lower than before?

ANSWER:

Add Mexico and Hong Kong.

$$\beta_p = \sum_i \alpha_i \beta_i = .80 \times (1.00) + .10 \times (0.62) + .10 \times (0.49) = .935 \text{ (lower } \beta\text{!)}$$

M2.II Long questions (20 points each)

1. (CHAPTER XV). Consider a three-year interest rate cap of 9% on annual (1 year) LIBOR. The cap amount is \$10 million. The cap trades on January 28 for effect on January 30.  $v=.15$ . At the time the cap is purchased, offered rates on time deposit are:

| Period | Offered Rate |
|--------|--------------|
| 1 year | 8.25         |
| 2 year | 8.50         |
| 3 year | 8.75         |

Value the cap. (Hint: there are two options in the cap. To apply the Black-Scholes formula, check the Normal Table on the last page of this exam).

ANSWER:

Option #1:  $f = [(1+.085 \times 365 \times 2/360)/(1+.0825 \times 365/360)-1] \times 360/365 = .080746$ .  
 $df = (1 + .085 \times 365 \times 2/360) = 1.17236$ .

$d1 = -.648347 \Rightarrow N(d1) = .25838$   
 $d2 = -.798347 \Rightarrow N(d2) = .21233$   
 $call = 1/(1.17236) \times [8.0746 \times (.25838) - 9 \times (.21233)] = .149531$

Value =  $.149531/100 \times 365/360 \times \text{USD } 10,000,000 = \text{USD } 15,160.803$

Option #2:  $f = [(1+.0875 \times 365 \times 3/360)/(1+.085 \times 365 \times 2/360)-1] \times 360/365 = .07890$ .  
 $df = (1 + .0875 \times 365 \times 3/360) = 1.26615$ .

$d1 = -.51440 \Rightarrow N(d1) = .303486$   
 $d2 = -.72653 \Rightarrow N(d2) = .233756$   
 $call = 1/(1.26615) \times [7.89 \times (.303486) - 9 \times (.233756)] = .22961$

Value =  $.22961/100 \times 365/360 \times \text{USD } 10,000,000 = \text{USD } 23,279.703$

Value of cap = Value option #1 + Value option #2 = USD 38,440.51

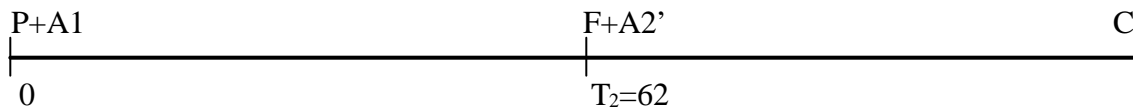
2.- (CHAPTER XIII). Consider the two deliverable French government bonds (BTNs) in Table 1. You want to determine on July 1, 1999, the cheapest to deliver BTN against the Sep.1, 1999 MATIF's BTN futures contract. Assume a 7% short rate.

TABLE 1

| Maturity      | Coupon | cf     | Future | Sept. Price | bpv  |
|---------------|--------|--------|--------|-------------|------|
| Sep. 15, 2008 | 9%     | 1.3625 | 93'08  | 126'05      | .051 |
| Mar. 15, 2009 | 8%     | 1.1837 | 93'08  | 109'01      | .092 |

B.- Now, consider a French issued Eurobond with a basis point value of .240. What is the number of LIFFE's BTN futures contracts needed to hedge EUR 40,000,000 in face value of the Eurobond on July 1, 1999?

ANSWER:



• Sep 15, 2008

Coupon = .09 (It's a French bond, annual coupon payments. See Table IX.E)

A1 = .09 x 288/365 x 100 = 7.10137 (Day count actual/365. See Table IX.E)

A2'(accrued interest from 7/1 to 9/1) = .09 x 62/365 x 100 = 1.52877

$F = (126.1563 + 7.10137) (1 + .07 \times 62/360) - 1.52877 = 133.3354$  (No coupon payment from 7/1 (t=0) to 9/1.)

$I = Z \times cf = 93.25 \times 1.3625 = 127.0531$ .

$BAC = F - I = 133.3354 - 127.0531 = 6.2823$

• Mar 15, 2009

Coupon = .08

A1 = .08 x 107/365 x 100 = 2.34521

A2'(accrued interest from 7/1 to 9/1) = .08 x 62/365 x 100 = 1.35891

$F = (109.0313 + 2.34521) (1 + .07 \times 62/360) - 1.35891 = 112.3348$

$I = Z \times cf = 93.25 \times 1.1837 = 110.380025$

$BAC = F - I = 112.3348 - 110.380025 = 2.0575$ . (Cheapest to Deliver!)

B.-

hedge ratio =  $-(bpv_{bond}/bpv_{CDB}) \times cf = -(0.240/0.092) \times 1.1837 = -3.0879$

Number of contracts = EUR 40,000,000 x -3.0879/EUR 100,000 = -1235.16 contracts.

That is, I need to short 1,235 contracts.

3. (CHAPTER XV). Consider a nine-month interest rate floor of 6% on 3 mo. LIBOR. The floor amount is \$10 million. The floor trades on August 27 for effect on September 1. Assume  $v=.10$ . At the time the floor is purchased, offered rates on time deposit are:

| Period  | Offered Rate |
|---------|--------------|
| 3 month | 6.05         |
| 6 month | 6.30         |
| 9 month | 6.65         |

Value the floor.

ANSWER:

$$\text{Option \#1: } f = [(1+.0630 \times 181/360)/(1+.0605 \times 91/360)-1] \times 360/90 = 6.4541$$

$$df = (1 + .0630 \times 181/360) = 1.03167$$

$$d1 = 1.48601 \Rightarrow N(d1) = .93136$$

$$d2 = 1.43608 \Rightarrow N(d2) = .92451$$

$$\text{call} = 1/(1.030167) \times [6.4541 \times (.93136) - 6 \times (.92451)] = 0.44971$$

$$\text{put} = \text{call} + 1/df \times (X - f) = .0096383$$

$$\text{Value} = .0096383/100 \times 90/360 \times \text{USD } 20,000,000 = \text{USD } 481.92$$

$$\text{Option \#2: } f = [(1+.0665 \times 272/360)/(1+.0630 \times 181/360)-1] \times 360/90 = 7.1206$$

$$df = (1 + .0665 \times 272/360) = 1.05024$$

$$d1 = 2.4668 \Rightarrow N(d1) = .99318$$

$$d2 = 2.3964 \Rightarrow N(d2) = .99172$$

$$\text{call} = 1/(1.05024) \times [7.1206 \times (.99318) - 6 \times (.99172)] = 1.06806$$

$$\text{put} = \text{call} + 1/df \times (X - f) = .0010829$$

$$\text{Value} = .0010829/100 \times 91/360 \times \text{USD } 20,000,000 = \text{USD } 54.75$$

$$\text{Value of floor} = \text{Value option \#1} + \text{Value option \#2} = \text{USD } 536.67$$

4.- (CHAPTER XV). On November 5, a swap dealer wants to price a one-year fixed-for-floating interest rate swap against the 3-month LIBOR, that starts on March 97. The fixed rate will be paid semiannually and is quoted bond basis. Find the swap coupon rate. Get the appropriate rates from the attached WSJ clip.

ANSWER:

|        | Price | Implied LIBOR | #days covered |
|--------|-------|---------------|---------------|
| Mar 97 | 94.64 | 5.36          | 92            |
| Jun    | 94.69 | 5.31          | 92            |
| Sep    | 94.64 | 5.36          | 91            |
| Dec    | 94.49 | 5.51          | 91            |

(1) Swap is 12-mo. Then,  $n=4$ . Need to calculate Implied 1-yr LIBOR

$$f_{0,12} = [(1+.0536 \times (92/360)) \times (1+.0531 \times (92/360)) \times (1+.0536 \times (91/360)) \times (1+.0551 \times (91/360))]^{360/366} - 1$$

$$= .0549373 \text{ (money market basis).}$$

(2) Converts this money market rate to its effective equivalent.

$$FRE_{0,12} = .0549373 \times (365/360) = .055703. \text{ (bond basis)}$$

(3)  $K=2$  (semiannual payments) equivalent semiannual bond basis.

$$SC = [(1.055703)^{1/2} - 1] \times 4 = .054948 \text{ (semianual bond basis)}$$

Therefore the swap coupon mid-rate is 5.50%. ¶

5. (CHAPTER XIII). Platini Co., one of the largest French perfume manufacturers in the world, wants to refinance debt amounting to GBP 100 million. An investment bank suggests issuing a straight bond with equity warrants attached. The investment bank has the following data available:

|  |                               |                    |
|--|-------------------------------|--------------------|
| GBP gilts yields:                                | 2-year 4.99 (s.a.);           | 3-year 5.75 (s.a.) |
| FRF government bond yield:                       | 1-year 6.5% (p.a.)            |                    |
| Platini GBP-Eurobond yield:                      | GBP gilts + 90 bps            |                    |
| Current Platini's share price (P <sub>0</sub> ): | FRF 75                        |                    |
| Historic dividend yield:                         | 3.00%                         |                    |
| Historic stock price volatility:                 | 2-year 15.50%;                | 3 year 17.00%.     |
| Outstanding warrants                             |                               |                    |
| Outstanding life:                                | 2½ years                      |                    |
| Current price (W <sub>0</sub> ):                 | FRF 7.40 (GBP 0.73)           |                    |
| Exercise price (X):                              | FRF 90                        |                    |
| Current exchange rate:                           | 10.10 FRF/GBP (.099 GBP/FRF). |                    |

Given the current tight market conditions, the investment bank suggests:

1. For the warrants: an equity content of 100%, an *exercise ratio* equal to 1, and a 3-year warrant (X=FRF 85).
2. For the bond: a 2-year full-coupon bond, denominations of GBP 5,000, and an issue price of 100%.

Total commissions are 2%. Due to competitive pressures, the investment bank decides to forgo 1% of the selling concession.

The investment bank also assumes a conversion exchange rate based on the current exchange rate.

Following usual market practices:

- i.- Write down the following generic terms for the issue:

|   |  |
|---|--|
| Amount of equity raised:                                  | $GBP\ 100,000,000 \times 1 \times 10.10\ FRF/GBP = FRF\ 1,010,000,000$   |
| Number of shares created on exercise:                     | $FRF\ 1,010,000,000 / FRF\ 85 = 11,882,353.$   |
| Number of warrants per bond:                              | $11,882,353 \times 1/20,000 = 594.11765$   |
| Value of the warrants attached to each bond of GBP 5,000: | $594.11765 \times FRF\ 12 = FRF\ 7,129.41 = GBP\ 705.81$<br>(705.81/5,000 = 14.12% of nominal amount of each bond) |

- ii.- Calculate the information required below to complete the pro forma of Platini's issue:

|              |                                |
|--------------|--------------------------------|
| 1. The bond  |                                |
| Coupon:      | $5\ 7/16 (\approx 5.41\%)$     |
| Yield:       | 5.95%                          |
| Issue price: | 100 (but bonds are sold at 99) |

## 2. The warrants

|  |                          |
|--|--------------------------|
| Price of warrant:  | FRF 12                   |
| Exercise price:  | FRF 85                   |
| Period of exercise:  | 3-yr                     |
| Exercise premium:  | 14.12                    |
| Global premium:  | 29.33 ( $= [85+12]/75$ ) |
| Issue price (bond and warrants):                             | 114.12 ( $100 + 14.12$ ) |
| Cost of funds (based on total issue price less commissions): | -0.006 (negative!)       |

### ANSWER:

#### • Pricing the new warrants:

- a) outstanding warrants' global premium:  $GP = (90 + 7.40)/75 = 1.299 (\approx 30\%)$
- b) new warrants: theoretical price (Black-Scholes): FRF 11.25  
GP-implied price:  $W_{\text{new}} = 75 \times (1.30) - 85 = \text{FRF } 12.40$

$\Rightarrow$  Any price between 12.40 and 11.25 is fine. Say, we fix  $W_{\text{new}} = \text{FRF } 12$ .

#### • Pricing the new bond:

- a) Convert s.a. yield on a p.a. yield:  $(1 + 0.0499/2)^2 - 1 = 0.0505$ .  
YTM (p.a.) =  $5.05 + 0.90 = 5.95$ .  $\Rightarrow$  coupon = 5.95 (if bond sold at  $P=100$ ).
- b)  $P=99$ , then coupon is reset at 5.41% or  $5 \frac{7}{16}$ .

6. (Chapter LN XVII). Mr. Fleichman is an investor of foreign nationality who has an account with a small Luxembourg bank. He does not pay taxes on his account. He only cares about U.S. dollar returns. Table 1 contains information about his account for June 1998 and for June 1999. The Cicely Index Fund has a passive approach and tracks the FT-Actuaries World Index, which has risen 2.8% last year. You should answer the following question:

- i. What is the total return on his portfolio?
- ii. What are the sources of this return, i.e., how much is capital appreciation, yield and currency movements?
- iii. How good is the manager in selecting securities?
- iv. Would you recommend Mr. Fleichman to change to the Cicely Index Fund?

ANSWER:

(i) ● USA

$$\begin{array}{llll}
 P_0 = 82,950 & & & \\
 P_1 = 84,275 & \Rightarrow & p_{USA} = .0159740 & \\
 D_1 = 5,260 & \Rightarrow & d_{USA} = .0634117 & \\
 s_{USA} = 0 & \Rightarrow & c_{USA} = 0 & \Rightarrow r_{USA} = .0793852
 \end{array}$$

● JAPAN

$$\begin{array}{llll}
 P_0 = 19,150,050 & & & \\
 P_1 = 19,550,000 & \Rightarrow & p_{JAP} = .02088770 & \\
 D_1 = 0 & \Rightarrow & d_{JAP} = 0 & \Rightarrow r_{JAP} = -.06264 \\
 s_{JAP} = -0.08181 & \Rightarrow & c_{USA} = -.0835217 &
 \end{array}$$

● GERMANY

$$\begin{array}{llll}
 P_0 = 297,600 & & & \\
 P_1 = 301,500 & \Rightarrow & p_{JAP} = .01310484 & \\
 D_1 = 20,100 & \Rightarrow & d_{JAP} = .0675403 & \Rightarrow r_{JAP} = -.127225 \\
 s_{JAP} = 0.04310 & \Rightarrow & c_{USA} = -.0465795 &
 \end{array}$$

$$r = \sum_j \omega_j r_{jD} = \sum_j \omega_j (p_j + d_j + c_j) = .1779 \times (.0793852) + .4518 \times (-.06264) + .3702 \times (.27225) = .0329208$$

$$(ii) r = \sum_j \omega_j p_j + \sum_j \omega_j d_j + \sum_j \omega_j c_j = .017130 + .036284 + (-.020498) = .032921$$

$$(iii) \text{ Security selection} = \sum_j \omega_j (p_j - I_j) = -.01272$$

(iv) Yes, the Cicely Fund outperformed the World Index (3.28% > 2.80%). The security selection performance, however, was not very good. The success of the Cicely Fund was based on country selection.

Table 1

**Account Valuation for Mr. Fleischman, June 1998.**

| Security             | Number of securities<br>or nominal | Market<br>Price | Dividend           | Total<br>(USD) |
|----------------------|------------------------------------|-----------------|--------------------|----------------|
| <b>Equity</b>        |                                    |                 |                    |                |
| U.S. 17.79%          |                                    |                 |                    |                |
| AT&T (USD)           | 1,000                              | 50.250          |                    | 50,250         |
| GTE (USD)            | 500                                | 30.000          |                    | 15,000         |
| NY Times (USD)       | 800                                | 22.125          |                    | 17,700         |
| Japan 45.18%         |                                    |                 |                    |                |
| Mitsubishi (JPY)     | 1,000                              | 6,500           |                    | 71,500         |
| Sony (JPY)           | 2,200                              | 5,750           |                    | 139,150        |
| Germany 33.59%       |                                    |                 |                    |                |
| DBenz                | (DEM)                              | 3,000           | 90.00              | 156,600        |
| <b>Bonds</b> 3.43%   |                                    |                 |                    |                |
| Government 7%        | 30,000                             | 92%             |                    | 16,008         |
| Total                |                                    |                 |                    | 466,208        |
| JPY 1 = USD .0110    |                                    |                 | US. Index = 100    |                |
| DEM 1 = USD .5800    |                                    |                 | Japan Index = 100  |                |
| DEM Bond Index = 100 |                                    |                 | German Index = 100 |                |

**Account Valuation for Mr. Fleischman, June 1999.**

| Security            | Number of securities<br>or nominal | Market<br>Price | Dividend<br>per share | Total<br>(USD) |
|---------------------|------------------------------------|-----------------|-----------------------|----------------|
| <b>Equity</b>       |                                    |                 |                       |                |
| U.S.                |                                    |                 |                       |                |
| AT&T (USD)          | 1,000                              | 51.325          | 3.51                  | 54,835         |
| GTE (USD)           | 500                                | 30.500          | 2.22                  | 16,360         |
| NY Times (USD)      | 800                                | 22.125          | 0.80                  | 18,340         |
| Japan               |                                    |                 |                       |                |
| Mitsubishi (yen)    | 1,000                              | 6,900           |                       | 69,690         |
| Sony (yen)          | 2,200                              | 5,750           |                       | 127,765        |
| Germany             |                                    |                 |                       |                |
| DBenz (DEM)         | 3,000                              | 91.00           | 6.00                  | 176,055        |
| <b>Bonds</b>        |                                    |                 |                       |                |
| Government 7%       | 30,000                             | 95%             | 2,100                 | 18,513         |
| Total               |                                    |                 |                       | 481,558        |
| JPY 1 = USD .0101   |                                    |                 | US. Index = 102       |                |
| DEM 1 = USD .6050   |                                    |                 | Japan Index = 105     |                |
| DM Bond Index = 101 |                                    |                 | German Index = 101    |                |