

KASNEB

CIFA PART III SECTION 6

DERIVATIVES ANALYSIS

FRIDAY: 27 May 2016.

Time Allowed: 3 hours.

Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.

QUESTION ONE

- (a) Discuss the following terms as used in the swaps market:
- (i) Index amortising swap. (2 marks)
 - (ii) Arrears swap. (1 mark)
 - (iii) Index differential swap. (2 marks)
 - (iv) Overnight index swap. (1 mark)
- (b) A two year swap with semiannual payments pays a floating rate and receives a fixed rate. The term structure at the beginning of the swap is as follows:

$$L_0(180) = 0.0583$$

$$L_0(360) = 0.0616$$

$$L_0(540) = 0.0680$$

$$L_0(720) = 0.0705$$

Where: $L_i(m)$ is the m-day LIBOR on day i.

In order to mitigate credit risk of the parties engaged in the swap, the swap will be marked to market in 180 days. Suppose it is now 180 days later and the swap is being marked to market. The new term structure is as follows:

$$L_{180}(180) = 0.0429$$

$$L_{180}(360) = 0.0538$$

$$L_{180}(540) = 0.0618$$

Required:

- (i) The market value of the swap per Sh.1 notional principal. Indicate the amount paid by each party. (6 marks)
 - (ii) The new fixed rate on the swap at which the swap would proceed after marking to market. (2 marks)
- (c) Fredrick Aloo offers fixed income portfolio management services to institutional investors. He would like to execute a duration changing strategy for a Sh.100 million bond portfolio for a particular client. This portfolio has a modified duration of 7.2. Fredrick plans to change the modified duration of the portfolio to 5.0 by using a futures contract priced at Sh.120,000 which has an implied modified duration of 6.25 and a yield beta of 1.15.

Required:

- (i) Determine the number of futures contracts that Fredrick Aloo should sell. (2 marks)
- (ii) Suppose that the yield on the bond has decreased by 20 basis points at the horizon date, the bond portfolio has increased in value by 1.5% and the futures price has increased to Sh.121,200.

Determine the overall gain on the portfolio and the ex-post modified duration as a result of the futures transaction. (4 marks)

(Total: 20 marks)

QUESTION TWO

- (a) Describe five ways that could be used to manage credit risk in derivatives markets. (5 marks)
- (b) European put and call options with an exercise price of Sh.45 will expire in 115 days. The underlying asset is priced at Sh.48 and makes no cash payments during the life of the options. The risk free rate is 4.5%. The put is selling for Sh.3.75 and the call is selling for Sh.8.

Required:

- (i) Using suitable computations, identify the mispricing in the call. (2 marks)
- (ii) Execute an arbitrage transaction. (4 marks)
- (c) On 10 January 2016, SCM Ltd. determined that it would need to borrow Sh.5 million on 15 February 2016 at 90 day LIBOR plus 300 basis points. The loan would be an add on interest loan in which SCM Ltd. would receive Sh.5 million and pay it back plus interest on 16 May 2016.

To manage the risk associated with the interest rate on 15 February 2016, SCM Ltd. buys an interest rate call that expires on 15 February 2016 and pays off on 16 May 2016. The exercise rate is 5% and the option premium is Sh.10,000. The current 90 days LIBOR is 5.25%. Assume that this rate, plus 300 basis points is the rate at which SCM Ltd. would borrow at for any period of up to 90 days if the loan were taken out today.

Interest is computed on the exact number of days divided by 360.

Required:

- Determine the effective annual rate on the loan when the 90 day LIBOR on 15 February 2016 is at 6%. (5 marks)
- (d) A futures contract has a current price of Sh.212. The initial margin requirement is Sh.10 and the maintenance margin requirement is Sh.8. An investor goes long 20 contracts and meets all margin calls and does not withdraw any excess margin.

The futures price in the days following are shown below:

Day	Futures price (Sh.)
0	212
1	211
2	214
3	209
4	210
5	204
6	202

Required:

- The investor's total gain or loss by the end of day 6. (4 marks)
- (Total: 20 marks)

QUESTION THREE

- (a) Differentiate between a "payer swaption" and a "receiver swaption". (2 marks)
- (b) Discuss the following terms as used in the options markets:
- (i) Naked position. (2 marks)
- (ii) Covered position. (2 marks)
- (iii) Stop loss strategy. (2 marks)
- (c) A Kenyan corporation with a Tanzanian subsidiary generates cash flows of Tsh.10 million in a year. The subsidiary is considering using a currency swap to lock in the rate at which it converts to Kenyan shillings. The current exchange rate is Ksh.0.825/Tsh. The fixed rate on a currency swap in Tanzania shillings is 5%.

Required:

- Determine the overall periodic cash flow from the subsidiary operations and the swap. (4 marks)

- (d) An airline expects to purchase 2 million barrels of jet fuel in 1 month and decides to use heating oil futures for hedging.

The table below gives the data on the change in jet fuel prices per barrel and the corresponding change in the futures price for the contract on heating oil that would be used for hedging price changes during the month:

Month	Change in futures price per barrel (x_i)	Change in fuel price per barrel (y_i)
1	0.021	0.029
2	0.035	0.020
3	-0.046	-0.044
4	0.001	0.008
5	0.044	0.026
6	-0.029	-0.019
7	-0.026	-0.010
8	-0.029	-0.07
9	0.048	0.043
10	-0.06	0.011
11	-0.036	-0.036
12	-0.011	-0.018
13	0.019	0.009
14	-0.027	0.032
15	0.029	0.032

The summarised calculations are as follows:

$$\begin{aligned}\sum x_i &= -0.013 \\ \sum y_i &= 0.003 \\ \sum x_i^2 &= 0.0138 \\ \sum y_i^2 &= 0.097\end{aligned}$$

Each heating oil contract traded has 42,000 barrels of heating oil.

Required:

The optimal number of contracts required for hedging.

(8 marks)

(Total: 20 marks)

QUESTION FOUR

- (a) Assess the effect of the following factors on option prices:

(i) Interest rates. (1 mark)

(ii) Volatility. (1 mark)

- (b) Jonathan Atwori is doing some scenario analysis on forward contracts. The process involves pricing the forward contracts and then estimating their values based on likely scenarios provided by the firm's forecasting and strategy department. The forward contracts with which Jonathan is most concerned are those on fixed income securities, interest rates and currencies.

Fixed income securities forward contract

The first contract he needs to price is a 270 day forward on a Sh.1 million Treasury bond with 10 years to maturity. The bond has a 5% coupon rate, has just made a coupon payment, and will make its next two coupon payments in 182 days and 365 days respectively. It is currently selling for Sh.98.25. The effective annual risk free rate is 4%.

Interest rates forward contract

Jonathan analyses forward rate agreements (FRA) using the LIBOR spot rate curve as follows:

30 day: 3.12%	60 day: 3.32%	90 day: 3.52%
120 day: 3.72%	150 day: 3.92%	180 day: 4.12%

After 30 days, Jonathan wants to value a Sh.10 million short position in the FRA. The 90 day forward rate in 30 days is now 4.14% and the original price of the FRA which was 4.30% for 120 day LIBOR has changed to 3.92%.

Currency forward contract

Jonathan also wants to price and value a currency forward on euros. The euro spot rate is 1.1854 USD. The dollar risk free rate is 3% and the euro risk free rate is 4%.

Required:

- (i) Determine the no arbitrage price for the forward contract on the Treasury bond. (2 marks)
 - (ii) Assume that the Treasury bond price decreases to Sh.98.11 (including accrued interest) over the next 60 days. Calculate the value of the short position in the 270 day forward contract on a Sh.10 million bond. (2 marks)
 - (iii) Calculate the price of a 2 x 5 forward rate agreement (FRA). (2 marks)
 - (iv) Determine the current value of the Sh.10 million FRA to the short position under the second scenario mentioned above. (2 marks)
 - (v) Calculate the no arbitrage price for a 1- year forward contract on the euros. (2 marks)
- (c) A stock index is at 755.42. A futures contract on the index expires in 57 days. The risk free rate is 6.25%. At expiration, the value of the dividends on the index is 3.94.

Assume one year has 365 days.

Required:

- (i) The appropriate futures price, using both the future value of the dividends and the present value of the dividends. (3 marks)
- (ii) The appropriate futures price in terms of the two specifications of the dividend yield. (3 marks)
- (iii) The futures price under the assumption of continuous compounding of interest and dividends based on the solution obtained in (c)(ii) above. (2 marks)

(Total: 20 marks)

QUESTION FIVE

- (a) Evaluate two applications of index futures. (2 marks)
- (b) Your country is in the process of establishing a derivatives market. After an advertisement in the local dailies for an expert consultant to offer advisory services on derivatives markets, you are recruited and the first task you are given is to advise the relevant committee on the challenges they expect to face while trading derivatives instruments.

Required:

Highlight three challenges that the prospective derivatives market is likely to face. (3 marks)

- (c) TSST Ltd. plans to borrow Sh.10 million in 30 days at 90 day LIBOR plus 100 basis points. To lock in a borrowing rate of 7%, TSST Ltd. purchases a forward rate agreement (FRA) at a rate of 6%. Thirty days later, LIBOR is 7.5%.

Required:

Demonstrate that TSST Ltd.'s effective borrowing rate is 7% if LIBOR in 30 days is 7.5%. (4 marks)

- (d) Fusions derivatives services (FDS) is an options trading company that trades in a variety of derivatives instruments. FDS has just sold 500 call options on a stock currently priced at Sh.125.75. The trading date is 18 May 2016. The call has an exercise price of Sh.125, 60 days to expiration, a price of Sh.10.89, and a delta of 0.5649. FDS contemplates delta-hedging this transaction by purchasing an appropriate number of shares. Any additional transactions required to adjust the delta hedge will be executed by borrowing or lending at the risk free rate of 4%.

FDS has began delta-hedging the option. Two days later, on 20 May 2016, the following information is provided:

Stock price	Sh.122.75
Option price	Sh.9.09
Delta	Sh.0.5176
Number of options	500
Number of shares	328
Bond balance	-Sh.6,072
Market value	Sh.29,645

Required:

- (i) Assuming that at the end of 19 May 2016, the delta was 0.6564, show how 328 shares could be used to delta-hedge 500 call option. (2 marks)
- (ii) Show the allocation of the Sh.29,645 market value of FDS's total position among stock, options and bonds on 20 May 2016. (2 marks)
- (iii) Demonstrate the transactions that must be done to adjust the portfolio to be delta-hedged the following day (21 May 2016). (4 marks)
- (iv) On 21 May 2016, the stock is worth Sh.120.50 and the call is worth Sh.7.88. Compute the market value of the delta-hedged portfolio and compare it with a benchmark, based on the market value on 20 May 2016. (3 marks)

(Total: 20 marks)

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