AG313 Treasury Management & Derivatives Coursework Examination

Lewis Britton

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1 Investment Strategy

1.1 Straddle (Question 1 (a))

Share Price	Call Profit	Put Profit	Straddle Profit
55	-8	28	20
65	-8	18	10
75	-8	8	0
$\boxed{85}$	-8	-2	-10
95	2	-2	0
105	12	-2	10
115	22	-2	20

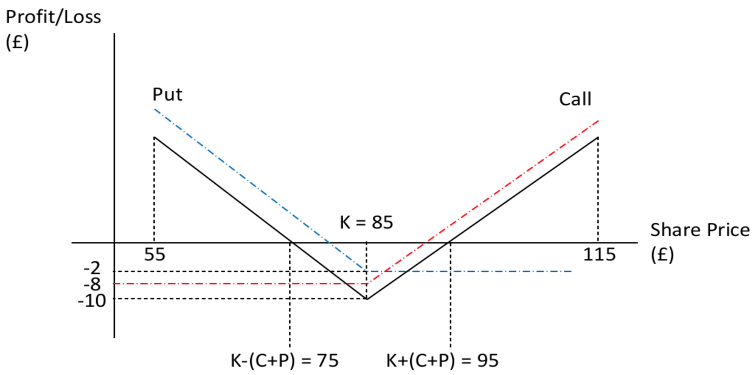


Figure 1: Straddle Payoff

1.2 Forward Rates (Question 1 (b))

$$F = S_0 e^{rT}$$

$$F = 30e^{0.08(0.5)}$$

$$31.2243 \therefore £31.22$$

- Enter a long-forward to buy oil in 6 months at the £31 per barrel
- Today, short-sell the oil for £30 per barrel and invest the earnings at the risk-free rate to yield the equivalent of £31.22 per barrel
- Close the short-sell after the 6 month period at the selling price of £31 per barrel
- Leaves the profit of $£31.22 - £31 = £0.22$

1.3 Bull Spread (Question 1 (c))

Profit = Payoff from Long Call + Payoff from Short Call

$$\text{For } S = 45: \ (0 - 6) + (0 + 4) = -2 \therefore \text{Loss of } £2$$

$$\text{For } S = 55: \ ((55 - 50) - 6) + (0 + 4) = 3 \therefore \text{Profit of } £3$$

$$\text{For } S = 45: \ ((65 - 50) - 6) + ((65 - 50) + 4) = 8 \therefore \text{Profit of } £8$$

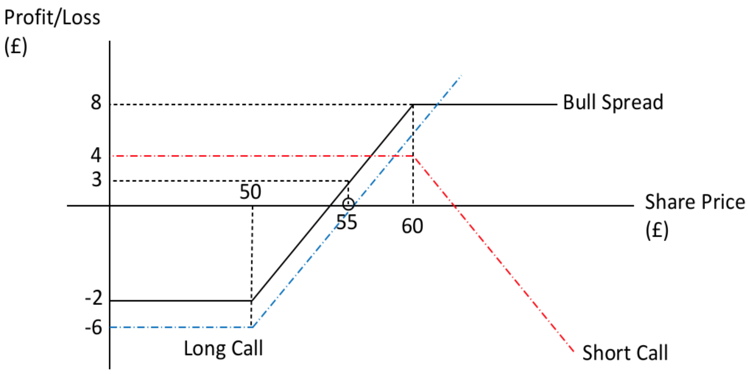


Figure 2: Bull Spread Payoff

1.4 Interest Rate Swap (Question 1 (d))

Profit = Difference in Fixed + Difference in Floating

$$0.015 - ((\text{LIBOR} + 0.006) - (\text{LIBOR} + 0.001))$$

$$0.010 \therefore 1.00\%$$

- Therefore, 100 basis points
- Bank recieve 0.2% → 20 basis points
- X & Y split 0.8% → 80 basis points → 40 basis points ea.
- X's payoff: 0.065 + 0.004 = 0.069 ∴ 6.9%
- Y's payoff: LIBOR + 0.006 +0.004 = LIBOR + 0.01 ∴ LIBOR + 1%
- Bank's (intermediary's) payoff: 0.2%

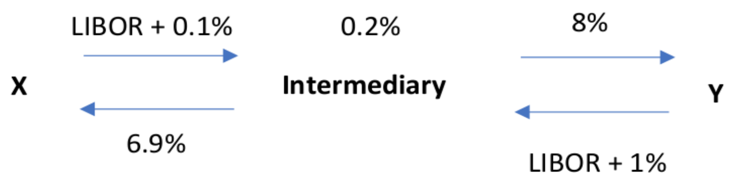


Figure 3: Swap Structure

2 Option Pricing

2.1 Binomial Option Tree: European Put (Question (a))

Step 1

$$u = e^{\sigma\sqrt{\Delta t}} = e^{0.30\sqrt{0.5}} = 1.2363$$

$$d = \frac{1}{u} = \frac{1}{1.2363} = 0.8088$$

$$p = \frac{e^{\sigma\sqrt{\Delta t}}}{u-d} = \frac{e^{0.30\sqrt{0.5}}}{1.2363 - 0.8088} = 0.5672$$

Step 2

$$S_u = pu = 10(1.2363) = 12.363$$

$$S_d = Pd = 10(0.8088) = 8.088$$

$$S_{u,u} = Pu^2 = 10(1.2363)^2 = 15.284$$

$$S_{u,d} = Pud = 10\left((1.2363)(0.8088)\right) = 9.999 \approx 10$$

$$S_{d,d} = Pd^2 = 10(0.8088)^2 = 6.542$$

Step 3

$$P_{u,u} = 0$$

$$P_{u,d} = K - S_{u,d} = 11 - 10 = 1$$

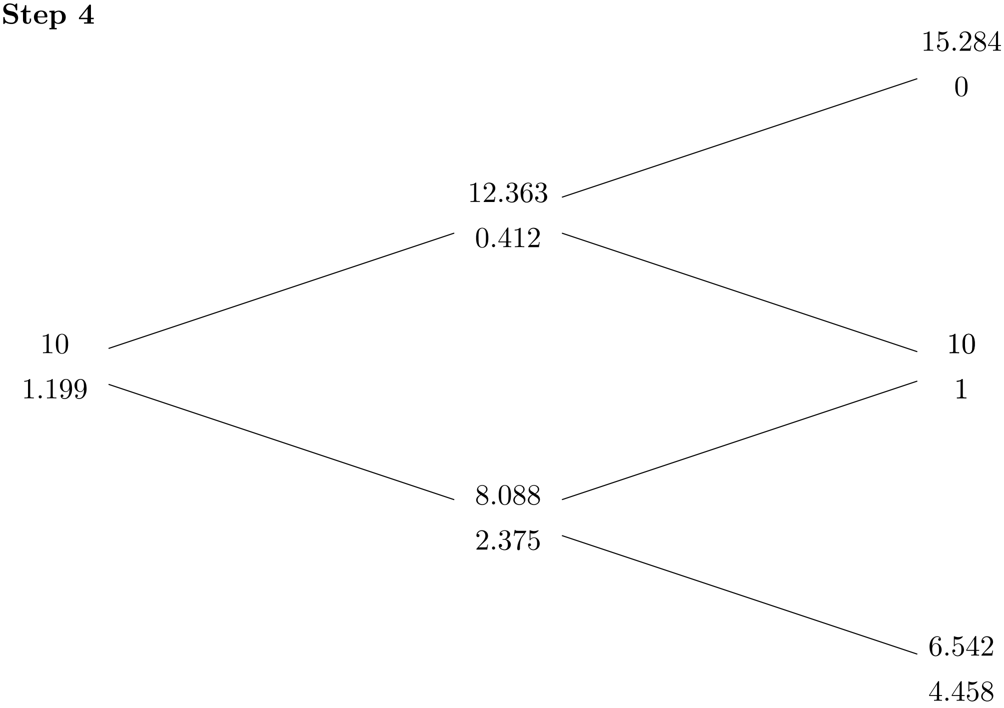
$$P_{d,d} = K - S_{d,d} = 11 - 6.542 = 4.458$$

$$P_u = \left((pP_{u,u}) + ((1-p)P_{u,d})\right)e^{-r\Delta t} = \left(((0.5672)0) + ((1-0.5672)1)\right)e^{-0.1(0.5)} = 0.412$$

$$P_d = \left((pP_{u,d}) + ((1-p)P_{d,d})\right)e^{-r\Delta t} = \left(((0.5672)1) + ((1-0.5672)4.458)\right)e^{-0.1(0.5)} = 2.375$$

$$P_0 = \left((pP_u) + ((1-p)P_d)\right)e^{-r\Delta t} = \left(((0.5672)0.4117) + ((1-0.5672)2.375)\right)e^{-0.1(0.5)} = 1.199$$

Step 4



2.2 Binomial Option Tree: Converting to Americal Put (Question (b))

Step 1

$$P_d = \max\{K - S_d, P_d\}$$

$$P_d = \max\{11 - 8.088, 2.375\}$$

$$P_d = \max\{2.912, 2.375\}$$

$$2.912 > 2.375$$

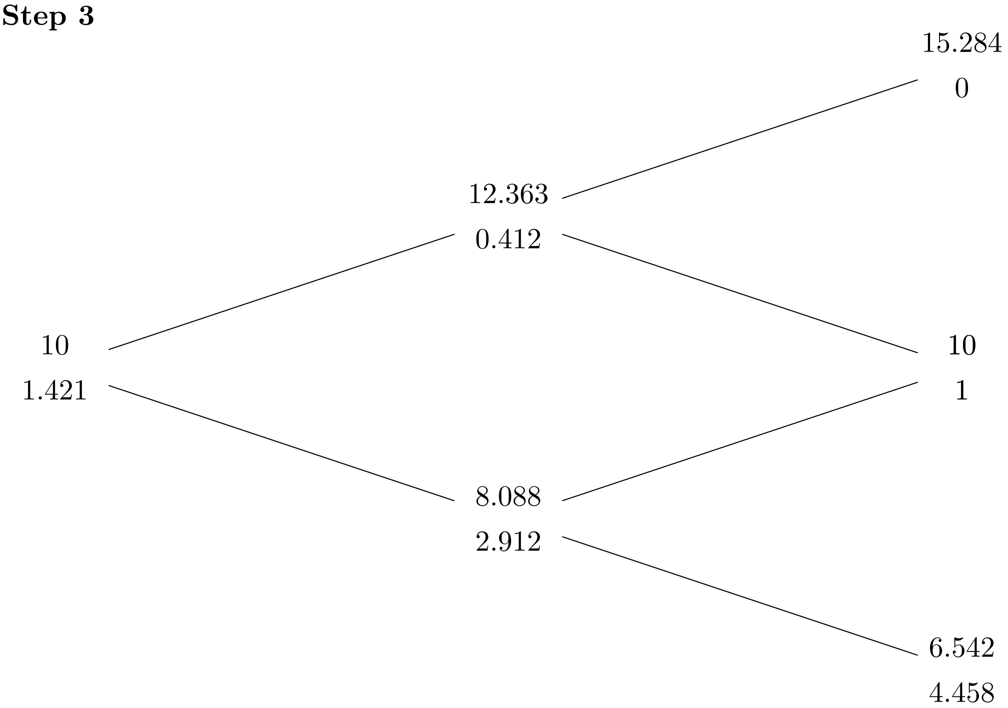
$$\therefore P_{d_A} = 2.912$$

Step 2

$$P_{0_A} = ((pP_{u_A}) + ((1-p)P_{d_A}))e^{-r\Delta t} = (((0.5672)0.4117)+$$

$$((1 - 0.5672)2.912))e^{-0.1(0.5)} = 1.421$$

Step 3



2.3 Black & Scholes Model (Question 2 (c))

European Call

$$d_1 = \frac{\ln\left(\frac{S}{K}\right) + T\left(r + \frac{\sigma^2}{2}\right)}{\sigma\sqrt{T}} = \frac{\ln\left(\frac{100}{110}\right) + \left(\frac{6}{12}\right)\left(0.06 + \frac{0.30^2}{2}\right)}{0.30\sqrt{\frac{6}{12}}} = -0.202$$

$$d_2 = d_1 - \sigma\sqrt{T} = -.202 - 0.30\left(\sqrt{\frac{6}{12}}\right) = 0.414$$

$$N(d_1) = 0.4207;\ N(d_2) = 0.3409$$

$$C_0 = SN(d_1) - Ke^{-rT}N(d_2) = 5.6833$$

$$\therefore £5.68$$

American Call

$$C_{0_A} = C_{0_E} = 5.6833$$

$$\therefore £5.68$$

European Put

$$P_0 = (C_0 + Ke^{-rT}) - S = \left(5.6833 + 110e^{-0.06\left(\frac{6}{12}\right)}\right) - 100 = 12.43$$

$$\therefore £12.43$$

Put-Call Parity Hold

Holds if: $(C_0 + Ke^{-rT}) = (P_0 + S)$

$$C_0 + Ke^{-rT} = 5.68 + 106.75 = 112.43$$

$$P_0 + S = 12.43 + 100 = 112.43$$

$$\therefore \text{ParityHolds}$$

2.4 Portfolio Value (Question 2 (d))

N short contracts to reduce risk by 0.25

$$N = \Delta\sigma\beta_p \left(\frac{V_P}{V_F}\right) = (0.25)(1.1)\left(\frac{720 \times 10^6}{6110.8(10)}\right) = 3240.165$$

Profit of forward position at expiration

$$(F_0 - F_T)(10)(N) = (6110.8)(10)(3240.165) = -7873200$$

$$\therefore \text{Loss of } £7,873,200$$

In $t = 3$ index Δ'd by

$$\frac{F_T - S}{S} = \frac{6353.8 - 6051.2}{6051.2} = 0.050$$

$$\therefore 5.00\%$$

Folio value expected to change by

$$\Delta\beta_{Index} = 0.05(1.1) = 0.055$$

$$\therefore 5.5\%$$

Value of folio at expiration

$$V_P(1 + E(\Delta V_P)) = 720 \times 10^6(1 + 0.055) = 759605235.3$$

$$\therefore £759,605,235.30$$

Folio: (+) 759605235.3
Dividends: (+) 450000
Futures: (−) 7873200
∴ Total = 7531820353

3-month return

$$\frac{\text{Total} - V_P}{V_P} = \frac{759605235.3 - 720 \times 10^6}{720 \times 10^6} = 0.0461$$

$$\therefore 4.61\%$$

Annualized return

$$(1 + 3 \text{ Month Return})^T - 1 = (1 + 0.0461)^{\frac{12}{3}} - 1 = 0.1975$$

$$\therefore 19.75\%$$

3 Treasury Management

3.1 Question 4 (a)

$$1000000(0.5116^{-1}) = 1954652.072$$

$$\therefore £1,954,652.07$$

3.2 Question 4 (b)

$$2000(0.6667^{-1}) = 2999.8500$$

$$\therefore £2999.85$$

3.3 Question 4 (c)

$$F_{180} = S_0 e^{rT} = 0.008058e^{0.0191(\frac{1}{2})} = 0.008135$$

$$\therefore 0.008135\frac{\$}{¥}$$

3.4 Question 4 (d)

- Buy \$10,000 at *ask* rate
- $10000(1.631^{-1}) = 6131.2078$
- $\therefore \$6131.21$
- Resell at *bid* rate
- $6131.2078(1.624) = 9957.0815$
- $\therefore \$9957.08$
- $\therefore$ Cost of Transactions $= \$42.92$

3.5 Question 4 (e)

$$\frac{\$}{e} = \frac{1}{\frac{e}{\$}} = \frac{e}{\$}^{-1} = 0.8^{-1} = 1.25$$

$$\therefore 1.25\frac{\$}{e}$$

3.6 Question 4 (f)

$$p = \frac{1+0.05}{1+0.03} = 1.0194$$
$$F = 1.5(1.0194) = 1.5291$$
$$\therefore 1.5291 \frac{\$}{e}$$

3.7 Question 4 (g)

- Margin Call when $1000 - 500 = 1000$ is lost
- $62500e(1.5\$) = \$95,750$
- $93750 - 1000 = 92750 \therefore \$92,750$
- Settlement price: $\frac{92750}{62500} = 1.484\frac{\$}{e}$req.