CHAPTER 23

Solutions

Exercise 1

TBC

Exercise 2

Let the principal amount to be invested (in dollars) be N = 100.

The iTraxx XO follows the path {330, 360, 320}. The Libor rate is fixed at L_t = 5%. The leverage ratio is λ = 2.

(a) The general strategy is to go through the following steps:

• Set $V_{t_0} = N_{t_0} = 100$. Calculate the floor

$$F_{t_0} = \frac{V_{t_0}}{(1 + r_t)^5} = \frac{100}{(1 + 0.05)^5} = 78.35$$

• The cushion is:

$Cu_{t_0} = 100 - 78.35 = 21.65.$

•Amount to be invested in risky asset is

$R_{t_0} = \lambda \times Cu_{t_0} 2.65 = 43.30$

which is the amount invested on iTraxx XO index. At the end of the year the spread received on the notional is $3.3 \times R_{t_0} = 1.43$. The balance $D_{t_0} = 100 - 43.30 = 56.70$ is kept in a default-free deposit account enjoying Libor. At the end of the year the spread received on the notional is $3.3 \times R_{t_0} = 1.43$.

• As the crossover index changes over time t1, t2, . . ., the positions on iTraxx XO and default-free bond investments are changed so as to keep the leverage ratio constant.

(b)

Period 1

Calculate $V_{t_1} = 100 \times \left(1 + L_{t_0}\right) + R_{t_0} \times c_{t_0} = 105 + 43.30 \times 0.033 = 106.43.$

Now

$F_{t_1} = \frac{100}{1.05^4} = 82.27.$

Thus, the new

$$R_{t_1} = 2 \times \left(V_{t_1} - F_{t_1}\right) = 2 \times 24.16 = 48.32.$$

Period 2

Calculate

$$V_{t_2} = V_{t_1} \times \left(1 + L_{t_0}\right) + R_{t_1} \times c_{t_1}$$

= 111.75 + 48.32 × (0.036) = 113.49.

Hence

$F_{t_2} = \frac{100}{1.05^3} = 86.38.$

Thus, the new

$$R_{t_2} = 2 \times \left(V_{t_2} - F_{t_2}\right) = 2 \times 27.11 = 54.22.$$

Period 3

Calculate

$$V_{t_3} = V_{t_2} \times \left(1 + L_{t_0}\right) + R_{t_2} \times c_{t_2}$$

= 119.16 + 54.22 × 0.032 = 120.90.

Here

$$F_{t_3} = \frac{100}{1.05^2} ==\ 90.70.$$

Thus, the new

$R_{t_3} = 2 \times \left(V_{t_3} - F_{t_3}\right)$= 2 × 30.200 = 60.40.

(c) Now there is a default and the index is c_{t_3} = 370. The notional investment iTraxx XO was 53.30 which becomes 53.40 × 29/30. An amount of 60.40/30 has to be paid, but with recovery rate 40%, 60.40/30 × 0.40 is recovered. Hence

$$V_{t_4} = V_{t_3} \times \left(1 + L_{t_0}\right) + \frac{R_{t_2}}{30} \times (1 - 0.4) \times R_{t_2} \times c_{t_3}$$

= 120.90 × (1.05) − 60.40/30× (1 − 0.4) + 60.40 × 29/30× 0.037= 127.90.

$$F_{t_4} = \frac{100}{1.05} ==\ 95.24.$$

Thus, the new

$R_{t_4} = 2 \times \left(V_{t_4} - F_{t_4}\right)$= 2 × 32.68=65.36