

Eco-30004 Tutorial 1

Question 1

An energy production firm is trying to decide whether to hedge. It feels that its greatest source of risk exposure lies in whether significant new crude oil discoveries will or will not be made next year. It believes that if none are made, energy prices will rise at a rate of 40%/year for the following two years, annual earnings before interest, depreciation, and taxes (EBIDT) will be \$70 million. But if the discoveries are made, prices will be flat, and EBIDT will be \$8 million. The probability that the new discoveries will be made is 30%. Interest expense will be \$5 million, and depreciation expense will be \$12 million. The tax rate is 40%. Compute the firm's expected net income and expected cash flow. Compute the variance of its net income.

Now suppose that if the firm hedges its exposure to changes in crude oil prices, it can reduce the uncertainty about its future EBIDT. Hedging would indicate the belief that if there is no oil discovered, EBIDT will be \$55 million; but if there are new discoveries, EBIDT will be \$43 million. Compute the firm's expected net income and expected cash flows. Compute the variance of its net income.

Answer 1

	New discoveries	No new discoveries
Probability	0.3	0.7
EBIDT	8,000,000	70,000,000
depreciation	12,000,000	12,000,000
<u>interest</u>	<u>5,000,000</u>	<u>5,000,000</u>
taxable income	-9,000,000	53,000,000
<u>taxes</u>	<u>0</u>	<u>21,200,000</u>
net income	-9,000,000	31,800,000
Cash flow	3,000,000	43,800,000

Expected net income = $(0.3)(-9,000,000) + (0.7)(31,800,000) = \$19,560,000$.

Cash flow is net income plus depreciation.

Expected cash flow = $(0.3)(3,000,000) + (0.7)(43,800,000) = \$31,560,000$.

Variance of net income = $(0.3)(-9,000,000 - 19,560,000)^2 + (0.7)(31,800,000 - 19,560,000)^2$
 $= 349,574,400,000,000$

The standard deviation of net income is \$18,696,908.84

If the firm hedges, then:

	New discoveries	No new discoveries
Probability	0.3	0.7
EBIDT	43,000,000	55,000,000
depreciation	12,000,000	12,000,000
<u>interest</u>	<u>5,000,000</u>	<u>5,000,000</u>
taxable income	26,000,000	38,000,000
<u>taxes</u>	<u>10,400,000</u>	<u>15,200,000</u>
net income	15,600,000	22,800,000
Cash flow	27,600,000	34,800,000

Expected net income = $(0.3)(15,600,000) + (0.7)(22,800,000) = \$20,640,000$.

Cash flow is net income plus depreciation.

Expected cash flow = $(0.3)(27,600,000) + (0.7)(34,800,000) = \$32,640,000$.

Variance of net income = $(0.3)(15,600,000 - 20,640,000)^2 + (0.7)(22,800,000 - 20,640,000)^2$
 $= 10,886,400,000,000$

The standard deviation of net income is \$ 3,299,454.50

The example illustrates how hedging reduces the volatility of a firm's net income and cash flow.

Question 2

Let's say that $F(0,T) = \$31$ per barrel and $S(T) = \$32.20$ per barrel. The forward contract covers 24000 barrels of oil. Which party, the one that bought the contract, or the one that sold the contract, made the profit? How much is the profit?

Answer 2

The party that was long the contract made a profit of $[S(T) - F(0,T)] * N = \$[32.20 - 31] / \text{bbl} * 24,000 \text{ bbls} = \$28,800$.

Question 3

On March 2, a firm sells a 3x8 FRA. The contracted forward rate is 5.93%. The principal amount is \$80 million. On the settlement date the 5 months spot interest rate is 6.04%. What amount must firm pay or receive?

Answer 3

There are $D = 153$ days between June 2 and November 2 (the forward period). The problem does not state how many days are defined to be in a year (B). Equation 3.1 determines the loss; a loss is realized because the FRA was sold, and interest rates rose. The spot 5-month Eurodollar rate (6.04%) on June 2 determines the loss for the firm. Assuming $B = 360$, the firm must pay \$36,463.97:

$$\left| \frac{P * [r(t1, t2) - fr(0, t1, t2)] * (D / B)}{1 + [r(t1, t2)] * (D / B)} \right|$$
$$= \left| \frac{\$80 \text{ million} [0.0604 - 0.0593] (153 / 360)}{1 + [(0.0604) (153 / 360)]} \right| = \$36,463.97$$

Question 4

A firm goes long a forward foreign exchange contract. The contract specifies that firm agrees to buy £5 million 6 months hence. The forward price is ¥168/£. Six months hence, the spot price is ¥180/£. At settlement, has the firm realized a profit or loss? What is the amount of that profit or loss?

Answer 4

- a. On the settlement day, the firm receives £5 million, and pays ¥840 million (£5 million times ¥168/£ = ¥840 million).
- b. The firm realizes a profit because it is long the forward contract to buy GBP at a price of ¥168/£. The actual spot price is higher than the originally agreed upon forward price. $S(T) > F(0,T)$. The profit is $[S(T) - F(0,T)]N = [¥180/£ - ¥168/£](£5 \text{ million}) = ¥60 \text{ million}$.

Question 5

A US mutual fund has invested in a portfolio of British stocks. However it does not wish to be exposed to exchange rate risk.

- a. Is the fund exposed to the risk that the \$/£ rate will rise or fall?
- b. To hedge, should buy or sell British pounds forward?
- c. Suppose that the fund invests \$16 million in British stocks. The spot exchange rate is \$1.68£. The forward rate for delivery in 6 months hence is \$1.673£. Six months later, the stocks are sold for £9 million, and the spot exchange rate is \$1.70£. What final profit or loss would the fund have realized, in terms of dollars, had it originally hedged its initial investment in British stocks? What was its dollar based annualized rate of return? What would have been its dollar denominated profit and rate of return, had it not hedged?

Answer 5

- a. The fund is exposed to the risk that the \$/£ exchange rate will decline. The fund has GBP denominated assets, but no GBP-denominated liabilities.
- b. GBP should be sold forward to hedge.
- c. Initially: buy \$16 million in British stocks. Thus £9,523,810 worth of British stocks can be purchased:

$$\begin{aligned} \$16 \text{ million} * \frac{\text{£}}{\$1.68} &= \text{£}9,523,810 \end{aligned}$$

If £9,523,810 are sold forward then the dollar loss of \$957,143 is computed as follows:

Sell the British stocks six months later for £9 million
Exchange the £9 million for \$ at the spot exchange rate:
 $\text{£}9 \text{ million} * \frac{\$1.70}{\text{£}} = \$15,300,000$

Loss on the forward contract = $\text{£}9,523,810 * (\$1.673/\text{£} - \$1.70/\text{£}) = -\$257,143$

The dollar loss is $\$15,300,000 - \$257,143 - \$16,000,000 = -\$957,143$

Dollar rate of return is $\$957,143/\$16,000,000 = -5.982\%$ during the six month period.

This can be annualized in either of two ways:

$$\text{simple: } -0.05982 * 2 = -0.1196 = -11.96\%$$

$$\text{compounded: } (1+r(0,0.5))^2 - 1 = (1 - 0.05982)^2 - 1 = (0.94018)^2 - 1 = 0.88394 - 1 = -0.11606 = -11.606\%$$

Had the fund not hedged, then the dollar loss of \$700,000 is computed as follows:

Sell the British stocks six months later for £9 million

Exchange the £9 million for \$ at the spot exchange rate:

$$\text{£9 million} * \frac{\$1.70}{\text{£}} = \$15,300,000$$

The dollar loss is $\$15,300,000 - \$16,000,000 = -\$700,000$

Dollar rate of return is $(\$15,300,000 - \$16,000,000) / \$16,000,000 = -4.375\%$ during the six month period. This can be annualized in either of two ways:

$$\text{simple: } -0.04375 * 2 = -0.0875 = -8.76\%$$

$$\text{compounded: } (1+r(0,0.5))^2 - 1 = (1 - 0.04375)^2 - 1 = (0.95625)^2 - 1 = -0.08559 = -8.559\%$$