

## Example 10

*Joseph buys a one-year long forward for 100 shares of a stock at \$74 per share. Samantha buys a call option of 100 shares of XYZ stock for \$76 per share. The exercise date is one year from now. The risk free effective annual interest rate is 6%. The premium of this call is \$6.4133 per share.*

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(i) Make a table with Joseph's profit and Samantha's profit when the spot price at expiration is \$50, \$70, \$90 and \$110. Compare these profits.

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(i) Make a table with Joseph's profit and Samantha's profit when the spot price at expiration is \$50, \$70, \$90 and \$110. Compare these profits.

**Solution:** (i) Joseph's profit is given by the formula

$$(100)(S_T - 74).$$

Samantha's profit is

$$\begin{aligned} & 100 \max(0, S_T - K) - 100 \text{Call}(K, T)(1 + i)^T \\ = & 100 \max(0, S_T - 76) - (100)(6.4133)(1.06) \\ = & 100 \max(0, S_T - 76) - 679.81. \end{aligned}$$

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(i) Make a table with Joseph's profit and Samantha's profit when the spot price at expiration is \$50, \$70, \$90 and \$110. Compare these profits.

**Solution:** (i) (continuation)

|                   |         |         |        |         |
|-------------------|---------|---------|--------|---------|
| Joseph's profit   | -2400   | -400    | 1600   | 3600    |
| Samantha's profit | -679.81 | -679.81 | 720.19 | 2720.19 |
| Spot Price        | 50      | 70      | 90     | 110     |

For high spot prices at expiration, Samantha's profits are smaller than John's profits. For low prices, Samantha's losses are smaller than Joseph's losses.

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(ii) Calculate Joseph's profit and Samantha's minimum and maximum payoffs.

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(ii) Calculate Joseph's profit and Samantha's minimum and maximum payoffs.

**Solution:** (ii) Joseph's minimum profit is  $-7400$ . Joseph's maximum profit is  $\infty$ . Samantha's minimum profit is  $-679.81$ . Samantha's maximum profit is  $\infty$ .

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(iii) Which is the minimum spot price at expiration at which Joseph makes a profit? Which is the minimum spot price at expiration at which Samantha makes a profit?

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(iii) Which is the minimum spot price at expiration at which Joseph makes a profit? Which is the minimum spot price at expiration at which Samantha makes a profit?

**Solution:** (iii) Joseph is even if  $S_T = 74$ . Samantha is even if  $100(S_T - 76) - 679.81 = 0$ , i.e.  $S_T = 76 + (679.81/100) = 82.7981$ .

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(iv) Draw the graph of the profit versus the spot price at expiration for Joseph and Samantha.

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(iv) Draw the graph of the profit versus the spot price at expiration for Joseph and Samantha.

**Solution:** (iv) The graphs of (long forward) Joseph's profit and (purchased call) Samantha's profit are in Figure 3.

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(v) Find the spot price at redemption at which both profits are equal.

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(v) Find the spot price at redemption at which both profits are equal.

**Solution:** (v) We solve  $(100)(S_T - 74) = 100 \max(0, S_T - 76) - 679.81$  for  $S_T$ . There is not solution with  $S_T \geq 76$ . If  $S_T < 76$  we have the equation  $(100)(S_T - 74) = -679.81$ , or  $S_T = 74 - 6.7981 = 67.2019$ .

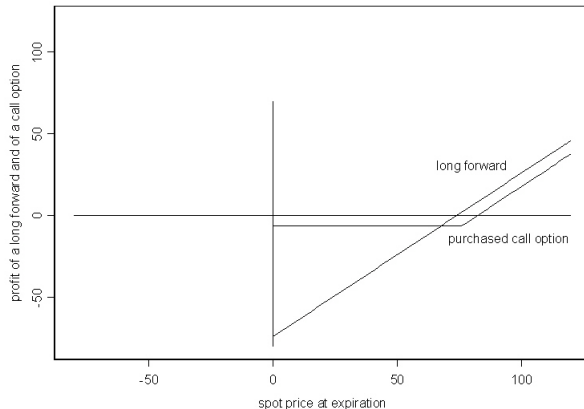


Figure 3: Example 10. Profit for long forward and purchased call.