FEB 16 2021 MATH 134B

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1. Terminologies

Dividend: A dividend is the distribution of some of a company's earnings to a class of its shareholders, as determined by the company's board of directors.

Example (How Dividend works)**.** *Important Dividend Dates*
Dividend payments follow a chronological order of events and the associated dates are important to determine the shareholders who qualify for receiving the dividend payment.
***-Announcement Date**: Dividends are announced by company management on the announcement date, and must be approved by the shareholders before they can be paid.*
***-Ex-Dividend Date**: The date on which the dividend eligibility expires is called the ex-dividend date or simply the ex-date. For instance, if a stock has an ex-date of Monday, May 5, then shareholders who buy the stock on or after that day will NOT qualify to get the dividend as they are buying it on or after the dividend expiry date. Shareholders who own the stock one business day prior to the ex-date - that is on Friday, May 2, or earlier - will receive the dividend.*
***-Record Date**: The record date is the cut-off date, established by the company in order to determine which shareholders are eligible to receive a dividend or distribution.*
***-Payment Date**: The company issues the payment of the dividend on the payment date, which is when the money gets credited to investors' accounts.*

2. Question solving

The 1-year forward price of copper is \$1/lb. The 1-year continuously compounded interest rate is 6%. One-year option prices for copper are shown in the table below

Table 1. Option prices

One-year option prices for copper		
Strike	Call	Put
0.9500	\$0.0649	\$0.0178
0.9750	\$0.0500	\$0.0265
1.0000	\$0.0376	\$0.0376
1.0250	\$0.0274	\$0.0509
1.0340	\$0.0243	\$0.0563
1.0500	\$0.0194	\$0.0665

For the following problems consider the following three firms:
XYZ mines copper, with fixed costs of \$0.50/lb and variable cost of \$0.40/lb.
Wirco produces wire. It buys copper and manufactures wire. One pound of copper can be used to produce one unit of wire, which sells for the price of copper plus \$5. Fixed cost per unit is \$3 and non-copper variable cost is \$1.50.

Telco installs telecommunications equipment and uses copper wire from **Wirco** as an input. For planning purposes, **Telco** assigns a fixed revenue of $6.20 for each unit of wire it uses.

In your answers, at a minimum consider copper prices in 1 year of $0.80, $0.90, $1.00, $1.10, and $1.20.

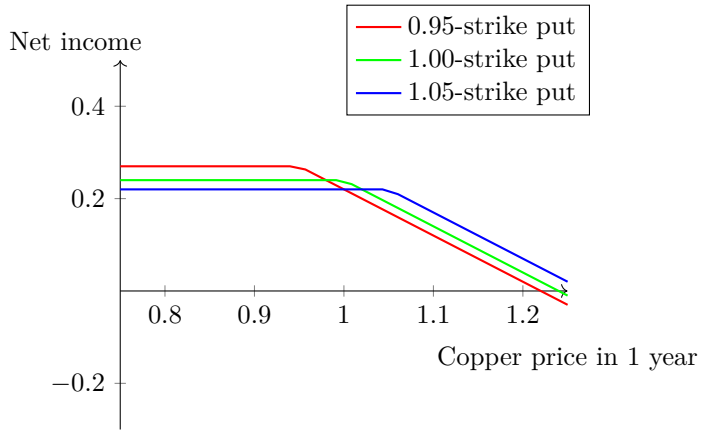
Question (4.9)**.** *Compute estimated profit in 1 year if* ***Telco*** *sells a put option with a strike of* $*0.95,* $*1.00, or* $*1.05. Draw a graph of profit in each case.*

Solution. Based on table 1, if we sell a 0.95-strike put to hedge our position, we have

Hedged profit of selling 0.95-strike put in 1 year					
Copper price in 1 year	$0.80	$0.90	$1.00	$1.10	$1.20
Cost of copper wire	-$5.80/lb	-$5.90/lb	-$6.00/lb	-$6.10/lb	-$6.20/lb
Revenue	$6.20/lb	$6.20/lb	$6.20/lb	$6.20/lb	$6.20/lb
0.95-strike put	-$0.15/lb	-$0.05/lb	$0/lb	$0/lb	$0/lb
Future value	$0.02/lb	$0.02/lb	$0.02/lb	$0.02/lb	$0.02/lb
Net income	$0.27/lb	$0.27/lb	$0.22/lb	$0.12/lb	$0.02/lb

Note that here, the future value is obtained by

$$\text{FV} = \$0.0178 \times \exp\left(6\% \cdot \frac{365}{365}\right) \sim \$0.02.$$



Also, if we sell a 1.00-strike put to hedge our position, we get

Hedged profit of selling 1.00-strike put in 1 year					
Copper price in 1 year	$0.80	$0.90	$1.00	$1.10	$1.20
Cost of copper wire	-$5.80/lb	-$5.90/lb	-$6.00/lb	-$6.10/lb	-$6.20/lb
Revenue	$6.20/lb	$6.20/lb	$6.20/lb	$6.20/lb	$6.20/lb
1.00-strike put	-$0.20/lb	-$0.10/lb	$0/lb	$0/lb	$0/lb
Future value	$0.04/lb	$0.04/lb	$0.04/lb	$0.04/lb	$0.04/lb
Net income	$0.24/lb	$0.24/lb	$0.24/lb	$0.14/lb	$0.04/lb

Note that here, the future value is obtained by

$$\text{FV} = \$0.0376 \times \exp\left(6\% \cdot \frac{365}{365}\right) \sim \$0.04.$$

Last, if we sell a 1.05-strike call to hedge our position, we obtain

Hedged profit of selling 1.05-strike put in 1 year					
Copper price in 1 year	\$0.80	\$0.90	\$1.00	\$1.10	\$1.20
Cost of copper wire	-\$5.80/lb	-\$5.90/lb	-\$6.00/lb	-\$6.10/lb	-\$6.20/lb
Revenue	\$6.20/lb	\$6.20/lb	\$6.20/lb	\$6.20/lb	\$6.20/lb
1.05-strike put	-\$0.25/lb	-\$0.15/lb	-\$0.05/lb	\$0/lb	\$0/lb
Future value	\$0.07/lb	\$0.07/lb	\$0.07/lb	\$0.07/lb	\$0.07/lb
Net income	\$0.22/lb	\$0.22/lb	\$0.22/lb	\$0.17/lb	\$0.07/lb

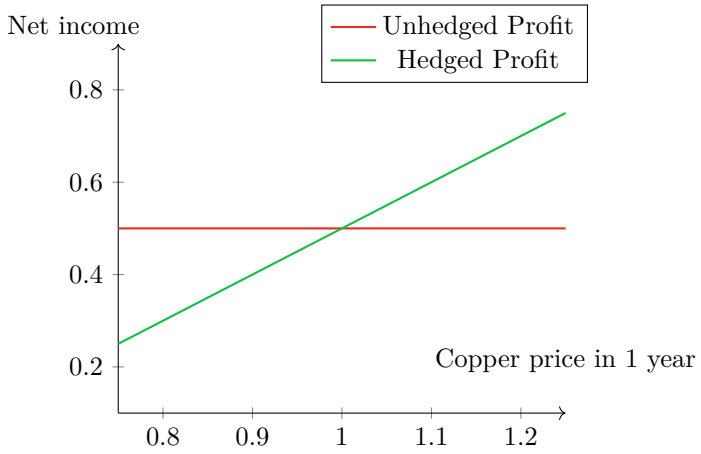
Note that here, the future value is obtained by

$$\text{FV} = \$0.0665 \times \exp\left(6\% \cdot \frac{365}{365}\right) \sim \$0.07.$$

□

Question (4.12)**.** *Suppose that* ***Wirco*** *does nothing to manage the risk of copper price changes. What is its profit 1 year from now, per pound of copper? Suppose that* ***Wirco*** *buys copper forward at \$1. What is its profit 1 year from now?*

Solution. Notice that **Wirco** produces wire. It buys copper and manufactures wire. One pound of copper can be used to produce one unit of wire, which sells for the price of copper plus \$5. Fixed cost per unit is \$3 and non-copper variable cost is \$1.50.



First, if **Wirco** does nothing to manage copper price risk, the profit 1 year from now will be the following

Unhedged profit					
Copper price in 1 year	$0.80	$0.90	$1.00	$1.10	$1.20
Copper cost	-$0.80	-$0.90	-$1.00	-$1.10	-$1.20
Fixed cost	-$3/lb	-$3/lb	-$3/lb	-$3/lb	-$3/lb
Variable cost	-$1.50/lb	-$1.50/lb	-$1.50/lb	-$1.50/lb	-$1.50/lb
Revenue	$5.80/lb	$5.90/lb	$6.00/lb	$6.10/lb	$6.20/lb
Net income	$0.50/lb	$0.50/lb	$0.50/lb	$0.50/lb	$0.50/lb

On the other hand, if **Wirco** hedges their position, notice that the 1-year forward price of copper is $1/lb, so the profit will be the following

Hedged profit					
Copper cost	-$0.80	-$0.90	-$1.00	-$1.10	-$1.20
Fixed cost	-$3/lb	-$3/lb	-$3/lb	-$3/lb	-$3/lb
Variable cost	-$1.50/lb	-$1.50/lb	-$1.50/lb	-$1.50/lb	-$1.50/lb
Revenue	$5.80/lb	$5.90/lb	$6.00/lb	$6.10/lb	$6.20/lb
Longing forward	-$0.20/lb	-$0.10/lb	$0/lb	$0.10/lb	$0.20/lb
Net income	$0.30/lb	$0.40/lb	$0.50/lb	$0.60/lb	$0.70/lb

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References

[1] Investopedia, *Dividend*.
https://www.investopedia.com/terms/d/dividend.asp