

## Executive Stock Options: Minimum Value and How to Get It

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1. Suppose the CEO receives a bonus of 10,000 European calls with 3 years to expiration and an exercise price of 100. What is the minimum value of these options on the date they are granted if the stock price is \$100 and the riskless 3-year interest rate is 6% (compound continuously)?

2. The Minimum Value of each call is:

$$C \geq \text{Max} [0, S - E e^{-rt}]$$
$$C \geq \text{Max} [0, 100 - 100 e^{-.06(3)}]$$
$$C \geq 16.473$$

The minimum value of the 10,000 calls is  $10,000 \times \$16.473 = \$164,730$

3. If the calls are nontransferable, how can the CEO capture the \$164,730 minimum value without incurring any risk?
4. Assume the CEO owns 10,000 shares of stock in her company. Her net worth before the bonus of 10,000 calls is:

$$10,000 \text{ shares} \times \$100 = \$1,000,000$$

5. The CEO can capture the minimum value of her calls by doing the following:
  - a) Recognizing that she has 10,000 calls, she can sell the 10,000 shares she owns and invest the proceeds in 3-year Treasury securities yielding 6%. The calls will allow her to retain the upside potential of the shares she sold. Let's examine the portfolio in 3 years to see what it is worth.

b) In 3 years the CEO's portfolio looks like this:

10,000 calls  
\$1,197,217 (= \$1,000,000 x  $e^{.06(3)}$ )

c) At the very least the CEO can recreate her original position by paying \$1,000,000 (= \$100 strike price times 10,000) to exercise the calls. This produces the following portfolio:

10,000 shares  
\$197,217

d) Thus at the end of 3 years the portfolio has an additional \$197,217 because the CEO used the calls to replace her stock and invested the proceeds of the stock sale. The present value (today) of that \$197,217 is \$164,730 (=  $197,217 \times e^{-.06(3)}$ ). Thus the CEO could realize \$164,730 today by selling off the interest on her \$1 million Treasury securities.

6. Are the calls worth exactly \$164,730?

a) Assume once again that the CEO starts with 10,000 shares. In portfolio A she gets a bonus of 10,000 calls and in B she gets a cash bonus of \$164,730.

A	B
10,000 shares	10,000 shares
10,000 calls	\$164,730

If the calls are worth exactly \$164,730 the CEO is indifferent between A and B.

b) To see if A and B are the same let's examine what the two portfolios are worth in 3 years, assuming the CEO follows our advice and sells her 10,000 shares in portfolio A and invests the proceeds in 3 year Treasury securities. The CEO would also invest portfolio B's \$164,730 cash bonus at 6% for 3 years. At the end the two portfolios look like this:

A	B
\$1,197,217 ( $=\$1,000,000 \times e^{.06(3)}$ )	10,000 shares
10,000 calls	\$197,217 ( $=164,730 \times e^{.06(3)}$ )

c) Examine A and B under two scenarios:

$$S > E \text{ and } S < E$$

d) Suppose  $S = 200$  ( $> E = 100$ )

Portfolio A:

The CEO exercises her calls by paying \$1,000,000 ( $E = \$100 \times 10,000$ ). She now has 10,000 shares worth \$2,000,000 plus \$197,217 in cash: Total value = \$2,197,217.

Portfolio B:

The 10,000 shares are worth \$2,000,000 plus \$197,217 in cash: Total value = \$2,197,217.

e) Suppose  $S = 50$  ( $< E = 100$ )

Portfolio A:

The calls are worthless ( $E = 100$ ) but the portfolio contains \$1,197,217 in cash. The CEO can buy stock (to return to her original position of 10,000 shares) by paying \$500,000 ( $=\$50 \times 10,000$ ). Her portfolio then looks like this:

10,000 shares worth.....	\$500,000
\$697,217 in cash ( $= \$1,197,217 - \$500,000$ ).....	<u>\$697,217</u>
Total Value	\$1,197,217

Portfolio B:

10,000 shares worth.....	\$500,000
\$197,217 in cash.....	<u>\$197,217</u>
Total Value	\$697,217

7. Conclusion:

Portfolio A is worth more than portfolio B when the stock price ends up below the exercise price. Hence, the calls are worth more than their minimum value because of downside protection. In particular, because the CEO allows the calls to replace the stock in her portfolio she does not lose any money when the stock declines below the exercise price of the calls.