§5. OPTIONS AND DERIVATIVES

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DERIVATIVES

Derivatives are financial contracts that *derive* their value from other assets or instruments including stocks, bonds, or commodities (gold, oil, materials, etc.). Examples include **options**, **futures**, and **forwards.**

OPTIONS

An investor can purchase an **option** contract that gives them the *right but not obligation* to buy or sell an asset in the future at a specified price.
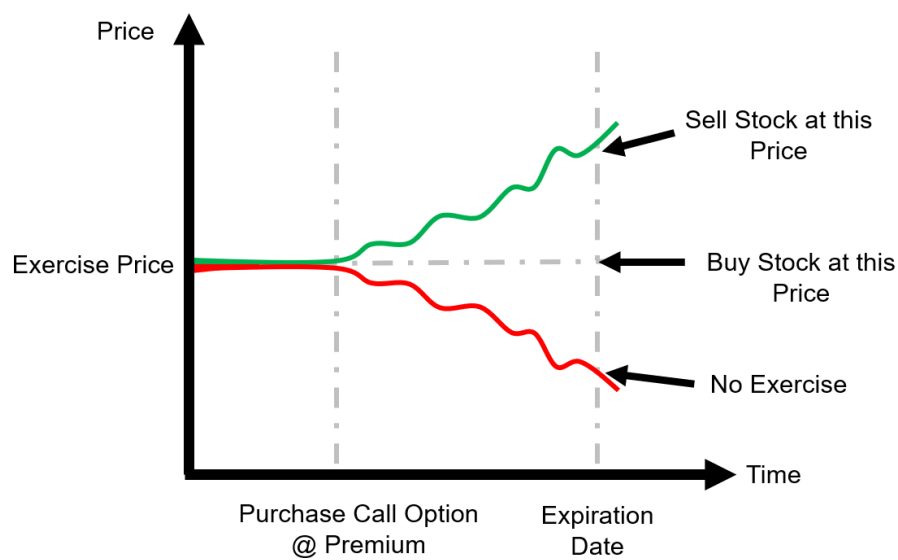
Call Options

Call Options: the investor pays a **premium** for a contract, giving them the right but not obligation to *purchase* an asset at an **exercise** or **strike** price on (or before) the **expiration** date. It is a bullish bet that the stock price will rise.

EXAMPLE: For a $3 premium, you can buy an option on Wolf Corp shares that will let you purchase 1 share in 3 months for $100. If the shares are worth $120 on the expiration date, you can buy it for that $100 exercise price, then immediately sell the stock for $120, netting a $120 - $100 - $3 = $17 profit. If the shares are worth $80 in 3 months, you will *not exercise the option* and only lose what you paid for the option: $3.

Figure 1: Visualizing a Call Option Payoff

> **i** While you have the choice to exercise, the financial institution that created the option, the **call writer**, does *not* have a choice. If you want to exercise, they must sell the stock to you at the exercise price. They earn the premium when you purchase the option, hoping that you choose to not exercise.

Put Options

Put Options: the investor pays a **premium** for a contract, giving them the right but not obligation to *sell* an asset at an **exercise** or **strike** price on (or before) the **expiration** date. It is a bearish bet that the stock price will fall.

> 🔖 **EXAMPLE:** For a $3 premium, you can buy an option on Wolf Corp shares that will let you sell 1 share in 3 months for $100. If the shares are worth $80 on the expiration date, you can buy those shares for that $80 in the market, then immediately sell the stock for the $100 exercise price, netting a $100 - $80 - $3 = $17 profit. If the shares are worth $120 in 3 months, you will not exercise the option and only lose what you paid for the option: $3.

Figure 2: Visualizing a Put Option Payoff
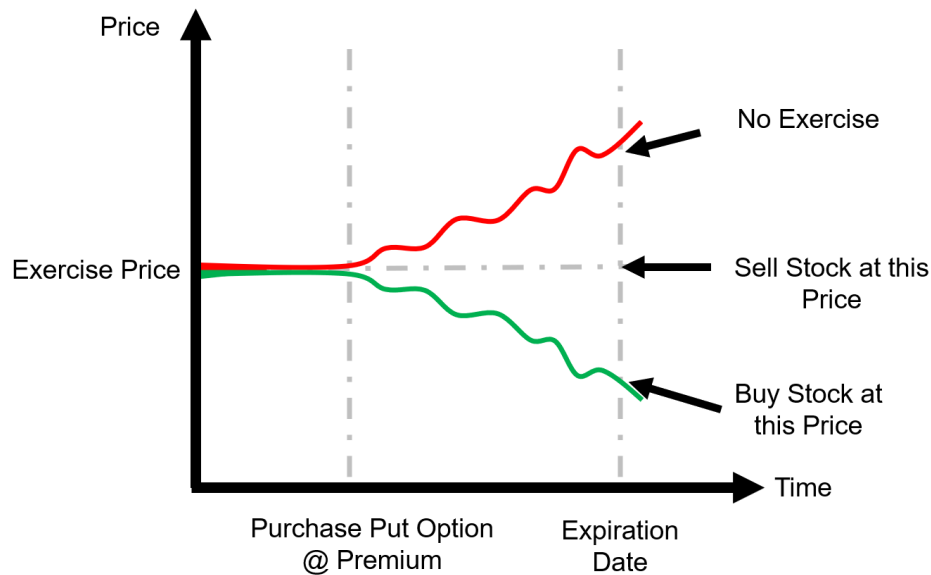
> **ⓘ** While you have the choice to exercise, the financial institution that created the option, the **put writer**, does *not* have a choice. If you want to exercise, they must buy the stock from you at the exercise price. They earn the premium when you purchase the option, hoping that you choose to not exercise.

There is an active **secondary market** for options. Rather than hold an option until expiration, options traders often enter and exit positions *before* the exercise date and with no intention of ever exercising. A trader might pay a $3 premium (the ASK) today for the option but be able to sell that option for $5 tomorrow (at a dealer's BID). Options can be longed or shorted.

> **ⓘ** Options are for <u>100 shares of the underlying stock</u>. However, they are quoted on a per-share basis. The premium an investor pays is 100 times the listed premium. If the investor exercises, they will pay (receive) 100 times the exercise price to buy (sell) 100 shares of stock associated with the call (put) option.

PRACTICE: Determine the profit and breakeven for long calls and puts. Using the Excel file *Option Payoffs* available at josephfarizo.com/fin366.html, collect real-world financial data for your inputs. While an option contract is for 100 shares, do everything on a *per share basis*. First, complete the table below with your collected data.

Call Option Data:

Strike	
Last Price	
Bid	
Ask	
Premium	

SOLUTION: The **breakeven** on a long call, the amount the stock must reach for you to have earned money on the option enough to offset the premium you've paid:

$$Breakeven\ on\ Long\ Call = X + Premium$$

$$Breakeven\ on\ Long\ Call = \qquad + \qquad =$$

The profit on a long call is determined by the following formula that considers the difference in the value of the stock at expiration and the exercise price, *as well as* the premium you paid for the option:

$$Profit\ on\ a\ Long\ Call = Max(Stock\ Price\ @\ Expiration - X, 0) - Premium$$

$$ProfitCall_{Stock\ Up} = Max(\qquad - \qquad, 0) - \qquad =$$

$$ProfitCall_{Stock\ Dn} = Max(\qquad - \qquad, 0) - \qquad =$$

Now, we will calculate the breakeven and profits on a long put.

Put Option Data:

Strike	
Last Price	
Bid	
Ask	
Premium	

[6]

$$Breakeven\ on\ Long\ Put = X - Premium$$

$$Breakeven\ on\ Long\ Put = \qquad\qquad - \qquad\qquad =$$

The profit on a long put is determined by the following formula that considers the difference in the exercise price and the value of the stock at expiration, *as well as* the premium you paid for the option:

$$Profit\ on\ a\ Long\ Put = Max(X - Stock\ Price\ @\ Expiration, 0) - Premium$$

$$ProfitPut_{Stock\ Up} = Max(\qquad\qquad - \qquad\qquad, 0) - \qquad\qquad =$$

$$ProfitPut_{Stock\ Dn} = Max(\qquad\qquad - \qquad\qquad, 0) - \qquad\qquad =$$

INTERPRETATION: The profits from holding calls and puts would be multiplied by 100 since each option contract is for 100 shares. The premium you pay would also be multiplied by 100. As the value of the stock increases, the profit from holding a call increases. As the value of the stock decreases, the profit to holding a call decreases. If an investor chooses not to exercise on the expiation date, they only lose what they paid in the premium.

> ★ If the underlying stock increases in value before expiration, a call option investor can sell their call for more than the premium they paid, and vice versa. If the underlying stock decreases in value before expiration, a put option investor can sell their put for more than the premium they paid, and vice versa.

[7]

EXAMPLE: Options can be very risky – and very profitable. Consider a call option with a $2 premium and $55 strike price on a stock trading at $50.

Stock Price @ Expiration	Action	Investor's Return on the Call[1]	Return on Stock[2]
$50	No Exercise	-100%	0%
$55	No Exercise	-100%	10%
$60	Exercise	150%	20%
$70	Exercise	650%	40%
$80	Exercise	1150%	60%

Losing the entire investment in an option is possible and feasible but returns on options can far outpace the returns of the underlying stock.

Option chains show the many calls and puts available to trade on a stock in the secondary markets. Nasdaq and Yahoo Finance are great resources.[3]

FUTURES & FORWARDS

Futures are contracts where two parties agree to exchange an asset for a specified price at some point in the future. These contracts trade on exchanges and include commodities such as corn, soybeans, gold, silver, crude oil, currencies, livestock, and even indices. These contracts are often used to **hedge** against price movements.

EXAMPLE: You enter into a contract today to purchase a bushel of corn at $4 in one year. If in one year corn is worth $5, you have made $1 per bushel (you only pay $4 for the corn at delivery and can sell it for $5 in the market). If in one year corn is worth $3, you have lost $1 per bushel (you *must* pay $4 but can only sell for $3). Prior to the maturity date, you can trade this contract you have entered into on an exchange.

Futures contract quotes are available at https://www.cmegroup.com.

Forwards are similar, but while futures are standardized and trade on exchanges, forwards are not standardized. They are negotiated directly between parties.

Unlike calls and puts, forwards and futures have no premium.

CRITICAL THINKING QUESTIONS

1. When you pay a premium to purchase a call, are you paying the dealer's BID or ASK?
2. When you pay a premium to purchase a put, are you paying the dealer's BID or ASK?
3. Why might an investor or trader hold a call or put with no intention of ever exercising?
4. You purchase a security for $10 that gives you the right to purchase a stock for $340 on December 31st. On December 31st, the shares are trading at $351. What type of security is this? Would you exercise? What if the shares were trading at $328 on December 31st?
5. You purchase a security for $8 that gives you the right to sell a stock for $286 on December 31st. On December 31st, the shares are trading at $321. What type of security is this? Would you exercise? What if the shares were trading at $225 on December 31st?
6. If you paid $10 for a call option last month with an exercise at $100 and the stock trades at $101 on the expiration date, why should you exercise *even though* your profit is negative?
7. What is the primary difference between calls/puts and forwards/futures?
8. How might forwards and futures "lock you into a loss" if the asset declines in value while buying calls and puts may not?
9. CHALLENGE **American options** allow the holder of the option to exercise at any time before the expiration date. **European options** allow the holder of the option to exercise only on the expiration date. If two options are identical except one is American-style and the other is European-style, which should be more valuable? (Note that the names do not necessarily require that the security be from America or from Europe.)
10. CHALLENGE An option is "**in the money**" when the exercise of the option would immediately produce a positive cash flow. For example, a call with an exercise price of $100 when the stock is trading at $110 is in the money. In perfectly efficient markets, what do we expect the minimum premium of such an option to be if we could immediately exercise and make $10? Why?
11. CHALLENGE An "**out of the money**" option is when exercise of the option would immediately produce a negative cash flow. Do we expect the premiums on out of the money options on a stock to increase or decrease as the time to expiration increase? What about for in the money options?
12. CHALLENGE Options can also be used as insurance. Explain how buying a call option on a stock while you have a short position in that same stock can act as insurance (a **protective call**)? Explain how buying a put option on a stock when you have a long position in the put's underlying stock can act as insurance (a **protective put**)?

ANALYTICAL QUESTIONS

1. Using the option chain from Nasdaq below, answer the questions that follow, assuming that the stock currently trades at $145.50:

Calls						Strike	Puts					
Last	Change	Bid	Ask	Volume	Open Int.		Last	Change	Bid	Ask	Volume	Open Int.
2.68	+0.03 ▲	2.58	2.65	1375	802	144.00	1.23	-0.61 ▼	1.24	1.28	3624	1429
2.08	+0.05 ▲	2.00	2.06	8367	2527	145.00	1.66	-0.66 ▼	1.63	1.69	6956	5315
1.58	-0.02 ▼	1.52	1.56	14165	1960	146.00	2.12	-0.70 ▼	2.14	2.21	5150	3306
1.15	-0.07 ▼	1.11	1.15	11218	3805	147.00	2.71	-0.74 ▼	2.49	2.81	2586	1676

   a. How much would the call with the exercise price of $145 cost an investor? What about the put with the exercise price of $147?
   b. If you had a call you'd like to sell that has an exercise price of $144, how much could you get? What if you had a put you want to sell that has an exercise price of $144?
   c. Show that your rate of return for holding a call that you purchased for $1.50 three weeks ago that has an exercise price of $145 would be 33.33% if you sold today.
   d. Which put would have a profit of $6.19 if an investor immediately bought the put, the stock price fell to $138, and they exercise?

2. Using the table below, verify using your own computations that the investor's return on the call with a premium of $2 and a strike price of $55 is 650% if the stock goes from $50 to $70. Show that the return on the stock alone would be 40% if the stock goes from $50 to $70. Hint: See footnotes 1 and 2 in the *Notes & References* section below. Verify other call and stock returns in the table for yourself.

Stock Price @ Expiration	Action	Investor's Return on the Call	Return on Stock
$50	No Exercise	-100%	0%
$55	No Exercise	-100%	10%
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$70	Exercise	650%	40%
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CFA QUESTIONS

1. A put option seller receives a $5 premium for a put option sold on an underlying with an exercise price of $30. What is the option seller's maximum profit under the contract?
    a. $5
    b. $25
    c. $30

2. Which of the following are true regarding the writer of options?
    a. The writer of a call option receives an upfront premium and must sell the stock to the call option investor if the call option investor chooses to exercise at the exercise price.
    b. The writer of a call option receives an upfront premium and has the option to sell the stock to the call option investor if the call option investor chooses to exercise at the exercise price.
    c. The writer of a put option receives an upfront premium and must sell the stock to the put option investor if the put option investor chooses to exercise at the exercise price.

3. A higher exercise price:
    a. Decreases the value of both a call and put option.
    b. Decreases the value of a call option.
    c. Decreases the value of a put option.

4. A higher underlying stock price:
    a. Decreases the value of both a call and put option.
    b. Decreases the value of a call option.
    c. Decreases the value of a put option.

NOTES & REFERENCES

[1] (New – Old) ÷ Old = (Value at Expiration – Premium) ÷ Premium
[2] (New – Old) ÷ Old = (Value of Stock at End – Value of Stock at Beginning) ÷ Value of Stock at Beginning
[3] See https://www.nasdaq.com/market-activity/quotes/option-chain and
https://finance.yahoo.com/quote/SPY/options?p=SPY
[4] CFA Question answers: 1) A, 2) A, 3) B, 4) C