Put-Call Parity Equation

Stock

- What are the economic attributes associated with owning an investment? (1) That the investment will return the market average; (2) That the investment will return more than the market average; and (3) That the investment will return less than the market average.
- I call (1) the “expected return.” I call (2) an “extraordinary gain” or “the upside.” I call (3) an “extraordinary loss” or “the downside.”
- Options separate the upside and the downside from the expected return.

Options

- Every option has two parties: the option holder and the option writer (also called the counterparty).
- The option holder has the right but not the obligation to exercise the option. If the holder elects not to exercise the option, we say the option lapses.
- All options have (1) an initial cost paid by the holder to the writer; (2) an underlying asset (what the option is an option on); (3) a strike price (the price at which the underlying will be sold between the two parties if the option is exercised); and (4) a duration (after which the option expires).

Option Example 1

- The option writer sells to the option holder the right (but not the obligation) to purchase one share of X Corp. stock in one year at a price of $106. The option holder immediately pays $2 to the option writer to obtain this valuable right.
- Terms:
  - The initial price is $2.
  - The strike price is $106.
  - The underlying asset is one share of X Corp. stock.
  - The duration is one year.
- The right to buy the underlying asset is called a “call” option.

Option Example 2

- The option writer sells to the option holder the right (but not the obligation) to sell one share of X Corp. stock in one year at a price of $106. The option holder immediately pays $2 to the option writer to obtain this valuable right.
- Terms:
  - The initial price is $2.
  - The strike price is $106.
  - The underlying asset is one share of X Corp. stock.
  - The duration is one year.
- The right to sell the underlying asset is called a “put” option.

Option Observations

- Regardless of the type of option, the option holder has a right against the option writer. That right will be exercised only if doing so is profitable for the option holder.
- The option writer cannot make the option holder do anything. That is, the option writer only has an obligation at the discretion of the option holder.

Exercise of a Call Option

- Assume publicly-traded X Corp. stock is trading for $100 per share, and assume the risk-adjusted market return on all assets is 6%.
- If one party purchases a one-year **call** option on a share of X Corp. stock for a price of $3, a duration of 1 year, and a strike price of $105, the holder of the option will exercise the option if the market price (called the “spot” price) of X Corp. stock exceeds $105. If, for example, the stock rises to $106 in one year, the option holder will exercise the option, pay $105 for the share, and immediately sell the stock of $106, for a gain of $1. However, because the option cost $3, the investor has a $2 net loss on the investment.

Exercise of an Option (continued)

- Now look at the counterparty. The counterparty was obligated to sell one share for $105. To get that share, the counterparty had to go into the market and purchase one share for the spot price of $106. When this share is then sold to the option holder for the strike price of $105, the option writer loses $1. But because the option writer received $3 for writing the option, the option writer has a net profit of $2 from the transaction.
- Thus, the option holder of a call option hopes the underlying increases in value while the option writer hopes it does not. The only possible profit to the option writer is from the initial sale price of the option.

Exercise of a Put Option

- Assume publicly-traded X Corp. stock is trading for $100 per share, and assume the risk-adjusted market return on all assets is 6%.
- If one party purchases a one-year **put** option on a share of X Corp. stock for a price of $3, a duration of 1 year, and a strike price of $105, the holder of the option will exercise the option if the market price (called the “spot” price) of X Corp. stock is less than $105. If, for example, the stock rises to only $102 in one year, the option holder will exercise the option, buy a share in the market for $102, and then sell that share to the option writer for $105 for the share, for a gain of $3. However, because the option cost $3, the investor has no net profit or loss on the investment.

Option Example 3: Facts

- The underlying is on share of X Corp., a publicly-traded company with a current spot price of $100 per share.
- The risk-free market return is 6% per year.
- The cost today of a one-year call option on a share of X Corp. stock with a strike price of $106 is $2.
- The cost today of a one-year put option on a share of X Corp. stock with a strike price of $106 is $2.
- Because the options have the same duration and the strike price for each is the expected value of the underlying asset, the cost of each should be the same (ignoring commissions).

Option Example 3: Possibilities

- Suppose an investor has $100 to invest and thinks that X Corp. will outperform the market.
  - She can buy one share for $100, thereby obtaining the expected return of $6 in one year as will as the possibility of extraordinary gains and losses. She thinks the likelihood of extraordinary gains exceeds the possibility of extraordinary losses.
  - She can **write a put option** on one share of X Corp. stock with a one-year duration, a strike price of $106, and will receive $2 from whomever buys the put option (her counterparty, the option holder in this case). She can then spend the $2 to **purchase a call option** on one share of X Corp. stock with a one-year duration and a strike price of $106.

Option Example 3: Possibilities (continued)

- At this point, the investor owns a call option, is the writer of a put option, and she still has her $100. She uses that $100 to buy a risk-free bond paying 6% (i.e., $106) in one year.
- How does this alternate, more complex investment strategy compare to simply buying the stock directly?

Option Example 3: Payoffs (Strike Price: $106)

Spot Price	Bond	Call Option	Put Option	Option Price	Net Return
120	106	14	0	2-2 = 0	120
102	106	0	-4	2-2 = 0	102
106	106	0	0	2-2 = 0	106

This shows that owning a call option, writing a put option, and investing in a riskless asset is equivalent to owning the underlying asset. Or: S = C – P + B. This is a true algebraic equation and can be rearranged to synthesize any of the individual components. For example, B = S + P – C, so that you can convert ownership of a risky share of stock by purchasing a put option and selling a call option, each having the same duration and a strike price equal to the expected return at maturity.

There is one additional thing to consider. When you purchase the underlying asset, you are betting on the market value of that asset. When you synthesize it with options, you are still betting on the market value of the asset <u>and</u> you are taking a risk that your counterparties will not go bankrupt.